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ON
CONCUSSION OF THE SPINE

NERVOUS SHOCK

OTHER OBSCURE INJURIES TO THE NERVOUS SYSTEM

IN THEIR

CLINICAL AND MEDICO-LEGAL ASPECTS

BY

JOHN ERIC ERICHSEN, F.R.S.

SURGEON EXTRAORDINARY TO THE QUEEN; EMERITUS PROFESSOR OF CLINICAL SURGERY IN UNIVERSITY COLLEGE, AND CONSULTING SURGEON TO THE HOSPITAL; EX-PRESIDENT OF THE ROYAL COLLEGE OF SURGEONS OF ENGLAND, AND OF THE ROYAL MEDICAL AND CHIRURGICAL SOCIETY, ETC., ETC.

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NOTICE.

THE publication of a new edition has given me the opportunity of carefully revising this work and of making a few additions to the text, which, however, has been left substantially unchanged.

J. E. E.

January 1882.

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PREFACE. . .

IN 1866 I published Six Lectures on certain obscure injuries of the nervous system commonly met with as the result of shocks to the body received in collisions on railways. My objects in that publication were to direct the attention of surgeons to a class of injuries that had hitherto been but little noted; to endeavour to throw some light on their true characters; and, lastly, to show that though they commonly arose from railway collisions, they were not peculiar to them, but might be the consequence of any of the more ordinary accidents of civil life.

These Lectures attracted some attention at the time. They were translated into German by Dr. Kelp, of Halle, were republished in America, and have long been out of print in this country.

In the present work will be found some of the results of my more recent and extended experience. In it the six original Lectures have been incorporated—not, however, without much alteration—and eight new Lectures have been added.

The scope of the work has been materially extended, and the title has been changed, so as to embrace the wider range of subjects of which it now treats. These have been considered rather from a purely clinical, than from a physiological or pathological, point of view. Throughout these Lectures, but more especially in those on Diagnosis and Prognosis, attention has been directed to the medico-legal aspects of this large, obscure, and important class of injuries of the nervous system.

To Mr. John Tweedy I am deeply indebted for much valuable assistance in carrying this volume through the press, and in relieving me to a great extent of those editorial duties which press somewhat heavily on one otherwise much engaged.

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OF
Cutaneous and Venereal Diseases

EDITED BY

HENRY G. PIFFARD, M.D.

Surgeon to Charity Hospital; Consulting Surgeon to St. Elizabeth Hospital;

AND

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ON
CONCUSSION OF THE SPINE
AND
NERVOUS SHOCK.

LECTURE I.

INTRODUCTORY REMARKS.

GENTLEMEN,—It is well known to every surgeon of experience that no injury of the head is too trifling to be despised. This observation, made of old by Hippocrates, may be applied with equal if not with greater justice to injuries of the spine. For if the brain is liable to suffer serious primary lesion and protracted secondary disease from the infliction of slight and perhaps, at the time, apparently trivial injuries to the head, the spinal cord is at least equally prone to become functionally disturbed and organically diseased from injuries sustained by the vertebral column.

My object in these Lectures will be to direct your attention to certain Injuries of the Spine that may arise from accidents that are often apparently slight, from shocks to the body generally, as well as from blows inflicted directly upon the back; and to describe the train of progressive symptoms that lead up to the obscure, protracted, and often dangerous diseases of the spinal cord and its membranes, that sooner or later are liable to supervene thereon.

These injuries of the spine and of the spinal cord occur not unfrequently in the ordinary accidents of civil life—in falls, blows, horse and carriage accidents, injuries in gymnasiums, &c., but in none more frequently or with greater severity than in those which are sustained by persons who have been subjected to the violent shock of a railway collision. And if in these Lectures I speak more of the injuries of the spine arising from this than from any other class of accidents, it is not because I wish to make a distinction in injuries of the spine according to their causes, and still less to establish anything like a speciality of 'railway surgery,' but rather because injuries of the nervous system of the kind we are about to discuss have become of much practical importance from the great frequency of their occurrence, consequent on the extension of railway traffic, and because they are so frequently the cause of litigation. There is also a special and painful interest attaching to them from the distressing character of the symptoms presented by the sufferers. Moreover, in these cases there is always a peculiar difficulty, which is often greatly increased by the absence of evidence of outward and direct physical injury, by the obscurity and insidious character of the early symptoms, the slowly progressive development of the secondary organic lesions, and the functional derangements entailed by them, and by the very uncertain

nature of the ultimate issues of the case. Thus they constitute a class of injuries that often tax the diagnostic skill of the surgeon to the very utmost. In his endeavours to unravel the complicated series of phenomena that they present, and in the necessity that frequently arises of separating those symptoms which are real from those which are merely the consequences of the exaggerated importance that the patient attaches to his injuries, the surgeon will be called upon to exercise much practical skill and judgment.

Every circumstance connected with the more serious injuries of the nervous system, whether affecting the brain, spinal cord, or peripheral nerves—whether arising from wounds, from fracture of the skull, or fracture and dislocation of the spine—have been so thoroughly studied by all practical surgeons that little now remains to be said on these subjects, and with them I have at present no concern. But the primary effects and the secondary results of *slight* injuries to the nervous system do not appear, as yet, to have received that amount of study and attention on the part of surgeons that their frequency and their importance alike demand. The neglect with which these cases have hitherto been treated appears the more extraordinary when we consider the peculiar interest that their phenomena always present, and the important position that they have, of late years, assumed in medico-legal practice. There is indeed no class of cases in which medical men are now so frequently called upon to give evidence in courts of law, as those which involve the many intricate questions that arise in actions for damages against railway companies for injuries of the nervous system, alleged to have been sustained by passengers in collisions; and there is no class of cases in which more discrepancy of surgical opinion may be elicited.

It is partly with the view of supplying a missing chapter in medical jurisprudence, which, as generally taught in the schools, does not deal sufficiently with surgical questions, and partly with the view and in the hope of clearing up some of the more obscure points connected with these injuries, that I bring this important subject before your notice. I believe that, as these cases come to be more carefully studied, and consequently better understood, much of the obscurity that has hitherto surrounded them will be removed, and we shall less frequently see those deplorable contests of professional opinion which we have been so often obliged to witness in our courts of law.

The importance of these inquiries has latterly assumed a new aspect from the very interesting fact pointed out by Brown-Séguard,¹ that in many animals morbid states of various kinds may be hereditarily transmitted as the results of injuries inflicted on the nervous system of one or other of their parents. Thus, for instance, this distinguished physiologist has experimentally proved that epilepsy may appear by transmission, in animals whose parents have been rendered epileptic by an injury of the spinal cord,² as well as in the offspring of those in which that disease had been induced by section of the sciatic nerve. Exophthalmia, malformations of the ears and toes, partial closure of the eyelids, hæmatoma, and dry gangrene of the ears, have all been thus produced in animals; and although there is no proof as yet that analogous effects can be developed in man by heredity from parents who have suffered an injury of the nervous system, yet we may fairly assume that such is the case; and now that attention has been called to this important subject, we may expect to find similar instances in the human being.

I purpose illustrating these Lectures by cases drawn from my own

¹ *Lancet*, vol. i. p. 7, 1875.

² *Proceedings of Royal Society*, Jan. 1869.

practice, and by a reference to a few of the more interesting published cases that bear upon the subject. In doing so, I shall confine myself to the details of a few selected instances. It would be as useless as it would be tedious to unduly multiply the illustrations, as they all present analogous trains of symptoms and phenomena. I wish particularly and very specially to impress upon you, that although I shall have frequent occasion to speak of 'shocks' to the nervous system arising from railway accidents, I do not consider that these injuries stand in a different category from accidents occurring from other causes in civil life; and it will be one of the main objects of these Lectures to show you that precisely the same effects may result from other and more ordinary injuries. It must, however, be evident to you all, that in no ordinary accidents can the shock, physical and mental, be so great as in those that occur on railways. The rapidity of the movement, the momentum of the persons injured and of the vehicle that carries them, the suddenness of its arrest, the helplessness of the sufferers, and the natural perturbation of mind that must disturb the bravest, are all circumstances which necessarily greatly increase the severity of the resulting injury to the nervous system, and which have led surgeons to consider these cases as somewhat exceptional and different from ordinary accidents. There is, in fact, much the same difference between these and the more ordinary injuries of the nervous system as there is between a gunshot wound and other contused and lacerated wounds of the limbs. The cause is special, and the results are peculiar; but though peculiar they are not so unlike those arising from other accidents as to justify us in regarding them as being in any essential respect distinct and different. The peculiarity of these obscure injuries of the nervous system caused by railway shocks is sufficiently great, however, to warrant us in grouping them together, and considering them as a whole in a separate chapter in the great book of Surgery.

Perhaps the one circumstance which more than any other gives a peculiar character to a railway accident is the thrill or jar, the '*ébranlement*' of French writers, the sharp vibration, in fact, that is transmitted through everything subjected to it. It is this vibratory shock or jar which by some is compared to an electric shock, by others to setting the teeth on edge, that causes a carriage to be shattered into splinters, and occasions the sharp tremulous movement that runs through every fibre of its occupants and that constitutes the shock. In addition to all this the body of the traveller is thrown to and fro, often five or six times, without any power of resistance or of self-preservation.

But although the intense shock to the system that results from these accidents naturally and necessarily gives to them a terrible interest and importance, do not for a moment suppose that these injuries are peculiar to or solely occasioned by accidents that occur on railways.

There never was a greater error. It is one of those singular mistakes that has arisen from men trusting too much to their own individual experience, and paying too little heed to the observations of their predecessors. It is an error begot in egotism and nurtured by indolence and self-complacency. It is easy for a man to say that such and such a thing cannot exist, because 'I, in my large experience at our hospital, never saw it,' whereas, if he would take the trouble, he would find, by the study of their works, that surgeons of equally large, or perhaps of far greater, experience in their generation have seen and described it.

Formerly this opinion might have been excusable; it is no longer so. The comparative rarity of these obscure injuries of the nervous system in ordinary hospital practice and in private, caused them either to be entirely overlooked, or to be regarded as mere surgical curiosities.

Now, however, since they occur, unfortunately, too frequently in groups, sometimes of scores at a time, they have been brought under the observation of every surgeon, and their symptoms, prognosis, diagnosis, and treatment form an important part of the professional occupation of practitioners in every part of the country, who may at any time be called upon to diagnose and treat such cases, or to give evidence concerning them.

If we look into the surgical literature of the past century we shall find that cases of slight accidents to the spine or head, followed by serious persistent or fatal results, were not unknown; but they were of such rare occurrence that surgeons of the greatest experience do not appear to have seen, a sufficiently large number to treat specially of them.

Sir Astley Cooper, who certainly enjoyed a wider range of experience in surgical practice than has ever before or since fallen to the lot of any one man in this country, said that his experience, extensive as it had been, was only as a bucket of water out of the great ocean of surgical knowledge.

In the writings of Sir A. Cooper himself, in those of his predecessors and contemporaries, especially of Boyer, of Sir C. Bell, and, at a later period, of Ollivier and Abercrombie, you will find many isolated cases recorded which prove incontestably that precisely the same series of phenomena that of late years have led to the absurd appellation of the 'Railway Spine,' had followed accidents, and had been described by surgeons of the first rank in this country and in France, a quarter of a century and more before the first railway was opened, and that they were then generally recognised as arising from the common accidents of civil life. The only difference is, that accidents have greatly increased in frequency and intensity since the introduction of railways, and these injuries have become proportionally more numerous and more severe.

I have hitherto spoken only of these injuries as occurring in the ordinary accidents of civil life and on the railways, but they are not unknown to the Army Surgeons. In the 'Army Medical Report,' issued by the United States Government on the Surgery of the Great War of the Rebellion, there are seventy-five cases reported under the head of 'Contusions and Miscellaneous Injuries of the Spine,' from which all cases of fracture and of dislocation are excluded. From this report the following facts may be gleaned. Of the seventy-five, two died from causes unconnected with the accident, twenty-seven were discharged from the service as unfit for duty, and three returned to easy duty, the remaining forty-three returned to military duty. No mention is made of the duration of the treatment in thirty-two of the cases. Of the remainder it is stated as follows: one, fourteen months; one, twelve months; and one, six months; three, five months; two, three months; one, two months; and two, under one month.

The causes of the injuries are stated as follows in thirty-eight cases:—

Falls from horses	14	died 1	recovered 6	discharged 7
Simple falls	15	" 1	" 6	" 8
Struck by branches. . . .	4	" 0	" 4	" 0
Blows from muskets	3	" 0	" 1	" 2
Railway accident	2	" 0	" 1	" 1

Bacon has truly said, 'They be the best physicians which, being learned, incline to the traditions of experience, or, being empirics, incline to the methods of learning.' The same remark is applicable to surgeons, and that observation is as true at the present day as when it was made, nearly three hundred years ago.

Yes, truly, Gentlemen, if you are 'empirics,' incline to the methods of learning. Do not trust wholly to your own 'empiricism;' in other words, to your own individual experience; but learn what has been seen by others of equal, perhaps of greater, experience than yourselves; as accurate in observing, and as truthful in recording. The study of the works of such men is not a vain and futile learning, but one replete with valuable results. In reading their works, you feel that you come into direct communion with these great men,—with the Boyers, the Bells, and the Coopers,—and from them you will learn many a lesson of practical wisdom, the direct result of their accurate observations.

But you may go further back than the writings of these great men, and you will find scattered here and there throughout medical literature some most interesting cases that bear upon this very point. You will find much in this literature that anticipates what are often erroneously supposed to be more recent discoveries. Many a man, imagining that he has struck out a new vein of truth, has found that years ago it had been explored and the ore extracted by his predecessors, and he has had to exclaim, '*Perant ante nos qui nostra dixerunt.*'

If you take up the third volume of the 'Medical Observations and Inquiries,' you will find that in 1766, more than one hundred years ago, a case is related by Dr. Maty of 'a Palsy occasioned by a fall, attended with uncommon symptoms,' which is of so interesting a nature, and which bears so closely upon our subject, that I feel that I need offer no apology for giving you an abstract of it here, although as it occurred between sixty and seventy years before the first railway was opened in this country, it might at first appear to have less relation to railway accidents than it really has, for in its course and symptoms it is identical with many of them.

This case, which is given at length, and which I shall abstract from the original, is briefly as follows:—

Count de Lordat, a French officer of great rank and much merit, whilst on his way to join his regiment, in April, 1761, had the misfortune to be overturned in his carriage from a pretty high and steep bank. His head pitched against the top of the coach; his neck was twisted from left to right; his left shoulder, arm, and hand were much bruised. As he felt at the time little inconvenience from his fall, he was able to walk to the next town, which was at a considerable distance. Thence he pursued his journey, and it was not till the sixth day that he was let blood on account of the injury to the shoulder and hand.

The Count went through the fatigues of the campaign, which was a very trying one. Towards the beginning of the winter (at least six months after the accident), he began to find an impediment to the utterance of certain words, and his left arm appeared to be weaker. He underwent some treatment, but without much advantage; made a second campaign, at the end of which he found the difficulty in speaking and in moving his left arm considerably increased. He was now obliged to leave the army and return to Paris, the palsy of the left arm increasing more and more. Many remedies were employed without effect. Involuntary convulsive movements took place all over the body. The left arm withered more and more, and the Count could hardly utter a few words.

This was in December, 1763, two years and a-half after the accident.

He consulted various physicians, and underwent much treatment without benefit.

In October, 1764, three years and a-half after the fall, Dr. Maty saw him. 'A more melancholy object,' he says, 'I never beheld. The

patient, naturally a handsome, middle-sized sanguine man, of a cheerful disposition and an active mind, appeared much emaciated, stooping, and dejected. He walked with a cane, but with much difficulty, and in a tottering manner.' His left hand and arm were wasted and paralysed; his right was somewhat benumbed, and he could scarcely lift it up to his head. His saliva dribbled away; he could only utter monosyllables, 'and these came out, after much struggling, in a violent expiration, and with a low tone, and indistinct articulation.' Digestion was weak, urine natural. His senses and the powers of his mind were unimpaired. He occupied himself much in reading and writing on abstruse subjects. No local tumour or disease was discoverable in the neck or anywhere else. From this time his health gradually declined, and he finally died on the 5th March, 1765, nearly four years after the accident.

On examination after death, the pia mater of the brain was found 'full of blood and lymph'; and towards the falx there were some marks of suppuration. The medulla oblongata is stated to have been greatly enlarged, being about one-third larger than the natural size. The membranes of the cord were greatly thickened and very tough. The cervical portion of the cord was hardened, so as to resist the pressure of the fingers.

'From these appearances,' says Dr. Maty, 'we were at no loss to fix the cause of the general palsy in the alterations of the medulla spinalis and oblongata.' The twisting of the neck in the fall had caused the membranes of the cord to be excessively stretched and irritated; the morbid changes then extended by degrees to the spinal marrow, which, being thereby compressed, brought on the paralytic symptoms.

This case is of the utmost interest and importance; and though it occurred and was published more than a century back, it presents in so marked a manner the ordinary features of 'Concussion of the Spine,' that it may almost be considered a typical case of one of those accidents.

The points to which I would particularly beg to direct your attention in this case are these:—

1st. That there was no evidence of blow upon the spine,—merely a twist of the neck in the fall.

2nd. That no immediate inconvenience was felt, except from the bruise on the shoulder and hand.

3rd. That the patient was able to walk a considerable distance, and to continue his journey after the occurrence of the accident.

4th. The symptoms of paralysis did not manifest themselves for several months after the injury.

5th. They were at first confined to the left arm and to the parts of speech.

6th. They very slowly but progressively increased, extending to the left leg and slightly to the right arm.

7th. This extension of paralysis was very gradual, occupying two or three years. The sphincters were not affected, and the urine was healthy.

8th. The general health gradually but slowly gave way, and death at last ensued, after a lapse of four years, by a gradual decay of the powers of life.

9th. After death, evidences of disease were found in the membranes of the cord, and the cord itself. The narrator of the case stating that the membranes were primarily, and the cord secondarily, affected.

You will find, as we proceed in the investigation of this subject, that the symptoms, their gradual development, and the after-death appearances presented by this class, are typical of the whole class of Injuries

of the Spine grouped together under the one common term 'Concussion,' from whatever cause arising.

The term 'Concussion of the Spine' has been objected to, and it has been proposed to substitute 'Concussion of the Cord,' on the ground that we say 'Concussion of the Brain' and not of 'the Head.' But the cases are not similar. The spine, irrespective of its cord, is a much more complicated structure than the head. In 'Concussion of the Spine' we have not only, and not even necessarily, an injury of the cord, but also, and perhaps solely, an injury of the osseous, fibrous, ligamentous, and muscular structures that enter so largely into the conformation and support of the vertebral column—of the nerves that pass across it—and of the membranes included within it. Injuries of these parts often occasion very grave and most persistent symptoms without any lesion whatever of the cord.

LECTURE II.

EFFECTS OF DIRECT AND SEVERE BLOWS ON THE SPINE.

It is not my intention in these Lectures to occupy your time with any remarks on those injuries of the spine that are attended by distinct and immediate signs of lesion, such as fracture or dislocation of the vertebral column, or direct wound of the cord itself. The nature and the consequences, proximate and remote, of such injuries as these are obvious, and are so well understood by all engaged in surgical practice, that the consideration of them need not detain us. And what I have to say about them I have stated at length elsewhere.¹

My present object is to call your attention to the effects, local and constitutional, immediate and remote, of certain forms of injury from which the spinal cord is liable to suffer without serious lesion of its protecting column or enveloping membranes. These injuries, on account of the obscurity of their primary symptoms, the gradual development of their secondary phenomena, and the ultimate severity and long persistence of the evils they occasion, are of the greatest interest to the practical surgeon.

In considering these injuries, I shall adopt the following arrangement:—

1. The effects of severe blows directly applied to the spine, but without obvious lesion of bone or ligament.
2. The consideration of the effects of slight and apparently trivial injuries applied directly to the spine.
3. The effects that injuries of distant parts of the body, or that shocks of the system, unattended by any direct blow upon the back, have upon the spinal cord.
4. The effects produced by sprains, wrenches, or twists of the spine.

Firstly. Let us inquire into the effects, immediate and remote, of those forms of concussion of the spinal cord which follow a *severe* degree of external violence applied to the vertebral column.

It is by no means easy to give a clear and comprehensive definition of the term, 'Concussion of the Spine.' Without attempting to do so, it

¹ *Science and Art of Surgery*, seventh edition, vol. i., chaps. xxiv. and xxv.

may be stated, that this phrase is generally adopted by surgeons to indicate a certain state of the spinal cord occasioned by external violence; a state that is independent of, and usually, but not necessarily, uncomplicated by any obvious lesion of the vertebral column, such as its fracture or dislocation,—a condition that is supposed to depend upon a shake or jar received by the cord, in consequence of which its intimate organic structure may be more or less deranged, and by which its functions are certainly greatly disturbed, so that various symptoms indicative of loss or modification of innervation are immediately or remotely induced.

The primary effects of these concussions or commotions of the spinal cord are probably due to molecular changes in its structure. The secondary are mostly of an inflammatory character, or are dependent on retrogressive organic changes, such as softening, &c., consequent on interference with its nutrition.

It would appear that surgeons and writers on diseases of the nervous system have included four distinct pathological conditions under this one term, 'Concussion of the Spine,' viz., 1. A jar or shake of the cord, disordering, to a greater or less degree, its functions, without any lesion perceptible to the unaided eye. 2. Compression of the cord slowly produced by the extravasation of blood. 3. Compression of the cord by inflammatory exudations, serum, lymph, or pus within the spinal canal; and, 4. Chronic alterations of the structure of the cord itself as the result of impairment of nutrition consequent on the occurrence of one or other of the preceding pathological states, but chiefly of the third. These various conditions differ remarkably from one another in their symptoms and effects, and have only this in common, that they are not dependent upon an obvious external injury of the spine, such as the laceration or compression of the cord by the fracture or dislocation of a vertebra.

Concussion or Commotion of the Spinal Cord as a result of severe and direct blows upon the back is a morbid condition that has long been recognised and carefully described by those who have written on the effects of injury of this important part of the body.

It must not be forgotten, however, that severe and direct blows on the back may develop disease in the vertebral column and the meninges in which the cord may become secondarily implicated, and which may creep on by continuity of structure to the membranes of the brain.

The changes set up in the structures that enter into the conformation of the vertebral column by direct blows on the back may terminate in caries, angular curvature, abscess, &c. This is matter of common, in fact every-day surgical observation. Cases of this kind will be referred to in the course of these Lectures. It will suffice here to say that such disease may be developed from the very earliest infancy to the adult age from such violence. I have even known the slapping of the back of a newly-born infant to make it breathe develop caries of the dorsal spine, and from that early age direct violence cannot be applied to the spine without imminent risk of inducing local disease.

Sir A. Cooper¹ relates two cases of concussion of the spine, one terminating at the end of ten weeks in complete, the other in incomplete recovery.

Mayo² relates two cases. In one at the end of six months there was no amelioration. In the other at the end of four months symptoms of inflammatory softening of the cord set in.

¹ *Dislocations and Fractures of Joints*, 8vo. ed., p. 526 *et seq.*

² *Outlines of Pathology* London, 1836.

Sir Charles Bell¹ relates two most interesting cases of concussion of the spine, both occasioned by falls and blows on the back. In one of the cases the symptoms were immediate, but in the other they developed themselves slowly after an interval of some months.

Boyer² relates two cases. In one the patient struck his loins by falling into a deep ditch. He was affected by complete paraplegia, and speedily died. On examination no morbid appearances could be detected, there being no fracture, dislocation, effusion, or any lesion of the cord or its membranes. In the other case, a man amusing himself with gymnastic exercises strained his back between the shoulders. He became paraplegic, and died in a few weeks. After death no lesion of any kind was found in the spine or cord.

Abercrombie, in his well-known and philosophical treatise on the Brain and Spinal Cord,³ has a short chapter on this injury, in which he relates several cases from his own observations and from the practice of others, in which the characteristic symptoms of concussion of the cord followed blows upon the spine.

Ollivier⁴ has collected, from his own practice and that of others, thirteen cases of this injury. They are detailed with much minuteness. Several of these proved fatal, and of these the after-death appearances are given at length.

The following cases will illustrate some of the chief points of interest in the development of the symptoms and progress of spinal concussion from the infliction of severe and direct injury to the spine.

Case 1. Fall on Back—Partial Paraplegia—Recovery.—A man, 42 years of age, a clerk, fell whilst getting down from the roof of an omnibus, and struck his back heavily upon the ground. He tried to get up, but was unable to do so, and was carried to University College Hospital, where he was admitted in February 1857, under my care.

On examination it was found that he had a transverse bruise upon the back, in the dorso-lumbar region, probably from coming in contact with the step of the vehicle in his fall. He suffered pain on pressure about the bruised part; but no irregularity in the line of the spinous processes or any other sign of fracture or of injury to the vertebræ could be detected. The ecchymosis extended over the two or three last dorsal and the first lumbar vertebræ. His consciousness was in no way disturbed. He could not stand, as his legs gave way under him. He complained of complete numbness in the left leg, but in the right there was a certain degree of sensibility associated with tingling, pricking sensations. When laid in bed he could not move the left lower extremity, but he could flex the right thigh upon the abdomen and draw up the knee, though he could not raise the foot. The catheter was passed and clear urine drawn off.

He was ordered complete rest in bed; five grains of calomel, to be followed by a purgative enema, and the use of the catheter, if necessary, every eighth hour.

Febrile reaction set in, which continued for three or four days. He was quite unable to empty the bladder; the urine was consequently drawn off by the catheter. There was no incontinence of flatus or of feces. The state of the lower extremities remained unaltered.

At the end of a week he was decidedly better; he could raise the right foot from the bed, and the normal sensibility of that limb had in a great measure returned. He could draw up the left knee, and there

¹ *Surgical Observations*. London, 1816.

² *Maladies Chirurgicales*, vol. iii., p. 135.

³ London, 1828, p. 375.

⁴ *Traité des Maladies de la Moëlle Épineière*. Paris, 1837.

was some sensation in the leg and in the dorsum of the foot. The retention of urine continued.

At the end of a fortnight motion and sensation had returned in the right lower extremity, but the left limb was still weak and partially numb, with formications and tinglings. He now began to pass his urine—which was acid—without the use of the catheter. During the whole of this period the only treatment that had been adopted was rest in bed, with an occasional aperient. He was now ordered to sit up, and had dry cupping to the lower part of the spine.

At the expiration of another week he was able to move about on his feet with a tottering, straddling gait, by the aid of a chair and stick. He now steadily improved both in appearance and in power of moving. At the end of the first month he could walk with but little assistance; he was still very weak in the left leg, which was partially numb; it felt as if asleep, and tingled.

Stimulating embrocations were ordered to the spine, and he was ordered the twelfth of a grain of perchloride of mercury in a drachm of compound tincture of cinchona thrice a day. Under this treatment he steadily improved, and was able to leave the hospital at the end of the sixth week, walking with the aid of a stick. He was treated as an out-patient with strychnine and iron, and the local application of galvanism, for two or three weeks longer, and then dismissed cured.

This case is related as an instance of not very uncommon occurrence, in which, after a severe and direct blow upon the spine, paraplegic symptoms are suddenly developed, which again disappear completely in the course of a few weeks under the influence of rest and appropriate treatment. The only point of special interest in this case is, that although there was paralysis and complete retention, the urine continued acid throughout. It is probable that the pathological lesion in such a case as this consists of some intra-vertebral extravasation of blood, the compression exercised by which occasions the symptoms, which disappear as the blood becomes gradually absorbed.

Case 2. Fall on Back—Partial Paraplegia—Cerebro-Meningeal Symptoms—Incomplete Recovery.—A painter, 30 years of age, was admitted into University College Hospital, under my care, in June 1865, under the following circumstances. He stated that whilst painting a house he overreached himself, and fell with the ladder to the ground, a height of about thirty feet, and struck his back upon a gravel walk. His hand was cut in the fall, but his head was uninjured. On admission he was found somewhat collapsed, cold, and with a feeble pulse. There was no evidence of fracture either of spine or pelvis, but the back was ecchymosed to some extent about the centre of the dorsal region. He could not stand, but when lying in bed could draw up the knees nearly to a right angle, although he was unable to raise the feet. He complained of numbness and tingling in both legs and feet, but could feel when pinched or pricked. The patient had perfect control over his sphincters, and the urine was acid.

He was treated by rest in bed, dry cupping to the spine, and occasional aperients. At the end of a month he had not improved, being as nearly as possible in the same state as on admission. He was now put on small doses of the perchloride of mercury in bark, and had counter-irritation applied to the spine. Some little amendment took place under this plan of treatment, and in August he was able to sit up, but could neither walk nor stand without support, and continued to complain of the numbness and tingling in his legs. Towards the end of the month he seemed to have acquired slight power over the legs, and could manage, by dragging them along, and leaning on a chair and stick or

crutch, to move across the ward. He now very slowly improved, and by the end of September was able to leave the hospital. He was emaciated, cachectic-looking, and could barely manage to walk and drag his leg, by holding on to the furniture or by pushing a chair before him. He continued through the winter mending but very slowly. Towards the early part of the following year he was taken charge of by the Sisters of Mercy, who sent him to their establishment at Clewer. There he gradually regained a certain degree of health and strength. I saw him again on April 20, exactly ten months after the accident; he was then in the following state.

He described himself as being languid, depressed, and as if going out of his mind. His memory had become very bad—at times all seemed a blank to him. When he went on an errand he often could not recollect what it was about; was always obliged to write it down. His thoughts were confused; he often mixed up one thing with another. He was very nervous and easily frightened. He dreamt much, and was told that he talked and cried out in his sleep.

He said he was 'not the same man that he was,' and thought he never would be. He could not do ordinary work as before the accident—only 'odd jobs.' He could not walk more than a mile, and could not carry a pail of water without great exertion.

He was never free from an aching, throbbing pain in the back; most severe in the middle dorsal region. There the spine was very tender on pressure, and the tenderness extended to some distance on either side of it, more especially on the left. This pain was greatly increased by movement of any kind, especially by bending backwards. He stooped with great difficulty, and was obliged to go upon one knee in order to pick anything off the floor. He walked in a shuffling, unsteady manner, and always used a stick. He complained of numbness and 'pins and needles' in the right leg and foot. There was no difference in the size of the limbs.

He had suffered since the accident from *muscæ volitantes* and coloured spectra, 'like the rainbow' before his eyes. Light did not distress him, but loud noises did. His hearing was very acute indeed.

No irritability of bladder; held and passed his water well; urine acid.

In December 1867, two years and a half after the occurrence of the accident, he was still suffering from very severe pain at the lower part of the spine and in the dorsal region. He walked with great difficulty in a bent posture, and was quite unable to do any active or continuous work. He was again admitted into the hospital, but did not materially improve under treatment.

This case presents a good example of concussion of the spine followed by partial paralysis of sensation and motion of the lower limbs without affection of the sphincters or alkalinity of urine, terminating in incomplete recovery.

It appears to me doubtful whether intra-vertebral hæmorrhage took place in this case; but there can be little doubt that the spinal cord had sustained some serious organic lesion which interfered with complete recovery.

In some cases, however, the result is not so satisfactory even as in this; the symptoms that are immediately developed continuing for many years, even for the remainder of the patient's life, without change.

Case 3. Blow on Spine and Head—Slow supervention of Paralysis—Fits—Death by falling into River.—H. N., aged 43, a carpenter at Bishops Stortford, admitted into University College Hospital, October 15, 1866. Had been a hard-working man of temperate habits; always

enjoyed good health till he met with the following accident. More than three years ago, one day in June 1863, he was assisting to load a waggon with woodwork, when just as it was about to be tied down with rope, some of it slipped and fell on to the side of the patient, who was stooping by the cart. Four pieces fell, the first of which struck him on the back of the head, knocked him down and stunned him. The other pieces fell across his back. They were heavy beams, intended for the roof of a church, 25 ft. long and 6 in. square. After the accident he was able to walk a short distance home, and had no paralysis afterwards. He was, however, laid up for four months. He was much bruised, and suffered from violent pains in the back of his head. He was treated with embrocations only.

At the end of four months he again went to work, though he had still some constant pain in the back, with every now and then a severe exacerbation, so that he was obliged to lay up for a few days. He continued in this state until June 1866, when he was suddenly affected with giddiness; on stooping he fell down. His back also became worse. His medical attendant then cupped and blistered him energetically, and at the end of seven weeks he was sufficiently improved to go to the seaside. He remained there a month, and was much better when he returned to work, but soon became as bad as before. He continued doing as little work as he was able, until October, when he came up to London. He did not suffer from giddiness until June 1866, three years after the accident. At the same time his sight began to fail. If he read for a short time, the letters began to dance before his eyes. He suffered also from noises in his ears and head, and from failure of memory, especially forgetting what he had just been told or what had recently happened.

About the same time also he began to suffer occasional paralysis of the right arm and hand, lasting from a few minutes to an hour. There was no pain in the arm at these times, but complete loss of both sensation and motion. The return of power was accompanied by the unpleasant sensation of 'pins and needles.' After July, however, he was not troubled with these attacks. He had never had rheumatism or gout, and had had but little carrying or lifting of weights in his work.

On admission the patient was tolerably stout, though he said he had lost flesh since the accident. He had a somewhat vacant expression of countenance, and a hesitating way of speaking. He was very easily confused, especially respecting names and dates. The muscles were well developed, though rather flabby, and patient generally presented slight evidences of illness. On applying pressure along the line of the vertebral spines three tender spots were met with in the lower cervical (fifth and sixth) middle dorsal and lumbar regions. The last was the most painful, the former less so. He complained especially of a sensation of cold water being poured down his spine, also of numbness down the back of his thighs.

Bowels very regular. He cannot sleep well at night. When he does sleep he is continually dreaming.

He was ordered to take the sixteenth of a grain of perchloride of mercury in an ounce of decoction of bark, three times a day. Blisters to be applied to the tender spots on the spine.

25th.—Spine has been repeatedly blistered both with liq. vesicatorius and emp. lyttæ, but patient's skin is very obstinate, and but little result has been produced. Condition much the same.

Nov. 2nd.—Patient has been kept in bed, lying a good deal on his face. His back has been well blistered, and he expresses himself much relieved. The tenderness at the upper part of the back has disap-

peared ; that in the lumbar region is not much altered. The pains up the back and occiput have also disappeared. Appetite good, bowels regular, but patient sleeps little and lightly.

12th.—Patient much the same. Rather less tenderness in the lumbar region. Still much insomnia. Blisters to be repeated.

17th.—Patient gets up daily. No pain in back or head ; no tenderness on pressure anywhere ; back still sore from blisters ; general health good ; sleeps better.

23rd.—No tenderness on pressure at any part of the back. The blisters are all but healed. Patient looks much better than on admission, and has lost much of his vacant expression. He has also less hesitation in his speech.

26th.—Patient says he is in better health than he has been in since the accident. Has nothing whatever to complain of.

After the patient's return home he was able to resume work to a certain extent. He was, however, seized with 'fits,' probably epileptiform, and in one of these fell into the river and was drowned, as I was informed by Dr. Glasscock.

This case is interesting, as showing, 1. The slow supervention of paralysis after a severe concussion of the spine from direct violence ; 2. The effect of treatment ; and 3. The supervention of 'fits,' as the paralytic symptoms declined.

The following¹ is one of the most remarkable cases on record, of long persistent paralysis after a blow on the spine, the loss of sensation being so complete that the patient submitted to the amputation of both thighs without feeling the slightest pain. As this case has never, I believe, been published in this country, and is of so very remarkable a character, I have thought that it might not be out of place to give an abstract of it here.

Case 4. Blow on Head and Back—Complete Anæsthesia of Lower Limbs—Amputation without Sensation.—A man, 22 years of age, in felling a tree, was struck on the back part of the head and between the shoulders by a large bough. This accident occurred in 1845. The force of the blow expended itself chiefly on the lower cervical spine and the shoulders. A complete paralysis of sensation and motion, of all the parts below this, was the immediate result. This condition continued without the slightest change. The vital and animal functions were naturally performed. Respiration, circulation, digestion, secretion, and assimilation were all about normal. There was a sensible increase in the frequency and volume of the circulation, and respiration was noticed to be slightly increased in frequency above the normal standard. The weight of the body became greater after than it had been before the injury, and the lower limbs retained their natural heat and physical development.

The patient evidenced an unusual share of mental vigour after the injury, and possessed a resolution and determination that are described as truly surprising in his forlorn and helpless condition. He threw himself into the midst of society for excitement, and was fond of travelling, lying on his back in his carriage.

In 1851, six years after the accident, he presented himself in the County Medical Society (Greene, New York), and requested the amputation of his lower extremities, which he stated were a burdensome appendage to the rest of his body, causing him much labour in moving them, and stating that he wanted the room they occupied in his carriage

¹ *Eve's Surgical Cases*, p 90 : and *New York Journal of Medicine*, 1853. By U. D. Purple, M.D., of Greene, New York.

for books and other articles. He insisted on the operation with his wonted resolution and energy. The surgeon whom he consulted at first refused to consent to amputation, not only objecting to so extensive a mutilation for such reasons as he gave, but fearing lest the vitality of the vegetative existence enjoyed by his limbs might be insufficient for a healthy healing process. The patient, still determined in his resolve to have the limbs cut off as a useless burden to the rest of the body, sought other advice, and at last had his wishes gratified.

Both limbs were amputated near the hip-joints, without the slightest pain or even the tremor of a muscle. The stumps healed readily, and no unfavourable symptoms occurred in the progress of perfect union by the first intention. In this mutilated state he was perfectly unable to move his pelvis in the slightest degree. He resumed his wandering life, and travelled over a great part of the States. He died in May, 1852, of disease of the liver, brought on by his excesses in drink, to which he had become greatly addicted since his accident. No post-mortem examination was made.

This case is a most remarkable one from several points of view, and from none more than this, that a double amputation of so serious a character could be successfully practised on a person affected by complete paraplegia, and yet that the stumps healed by the first intention. Besides this remarkable fact, there are two special points of interest in this case which bear upon the subject that we are now considering, viz., that the weight of the body is stated to have increased after the accident, and that the limbs which were so completely paralysed as to admit of amputation without the patient experiencing the slightest sensation of pain, had in no way wasted during the six years that they had been paralyzed, but retained 'their normal physical development,' as is expressly stated in the report of the case. We can have no stronger evidence than this to prove that mere disuse of a limb for a lengthened period of years even, is not necessarily followed by the wasting of it.

I will now proceed to relate a series of cases of injury of the spine from direct violence, unattended by signs of fractures or dislocations, which will tend to prove many facts of interest in reference to concussion of the cord.

Thus Case 5 shows that a concussion of the spine may be followed by paralysis of one limb only. Case 6 is one of paraplegia, with recovery, following fall on back. Case 7 shows general paralysis from fall from horseback, and concussion of spine. Case 8 is an instance of the evils resulting from vertical concussion of the spine. Case 9 is an instance of the slow development of symptoms after spinal concussion. Case 10, another instance of slow development of symptoms. Case 11 illustrates the condition of a patient sixteen years after concussion of the spine; and Cases 12 and 13 are instances of death following concussion of the spine.

Case 5. Direct Blow on Cervical Spine—Paralysis of Left Arm.—W. C., aged 62, was sent to me on April 8, 1870, by Dr. Kydd. Whilst felling a tree last year he was struck by a heavy branch on the left side of the neck, shoulder, and spine. There was no fracture or dislocation; the severity of the blow was expended on the side of the neck, chest, and shoulder; the head was not struck. The whole of the left arm instantly became paralysed, both as to sensation and motion, and had been so ever since. On examination, I found the muscles attached to the scapula and the humerus were wasted to a considerable extent, as were also those of the arm and forearm. The limb was rigid, the joints could not be flexed without a very considerable amount of pain. The fingers were partly flexed, and sensation was entirely lost below the

elbow. Above this part it was normal. He suffered severe pain along the course of the ulnar and median nerves, which came on in spasms and was very intense. There was tenderness on pressure from the sixth cervical to the fifth or sixth dorsal vertebra, and constant pain there. The case appeared to be one of paralysis of the nerves of the upper extremity, from a direct blow on the spine, about the region of the brachial plexus on the left side.

Case 6. Concussion of Spinal Cord from a Fall out of Bathing-Machine—Uncomplicated Paraplegia—Recovery.—A young gentleman, aged 14, after bathing at Weymouth, on September 9, 1873, slipped off the steps of the machine, and fell backwards into shallow water, striking the sandy bottom. He received no bruise or other mark of external injury; was not stunned or even rendered momentarily unconscious. But he felt as if he had sprained his back. He got out of the water unaided, was assisted to dress, and walked home, a distance of a few hundred yards. He was then obliged to lie down, as his legs felt weak and numb. The weakness and numbness gradually increased, so that he could not walk or even stand. He was brought up to London in an invalid carriage, and I saw him on September 19, in consultation with Dr. Playfair, and Mr. Myers of the Coldstream Guards.

I found him a stout, healthy, well-grown lad, perfectly well to all appearance, except for the paraplegia. On examination we found that the left leg was much more paralysed than the right. He was quite unable to stand, even when supporting himself by his hands; on attempting to do so, his knees bent under him and he sank down. When lying in bed on his back, he could draw up, cross, and kick out his legs, apparently quite in a natural way. But on closer examination we found the following conditions:—

1. The right leg and thigh could be moved freely. The four movements of the foot could be moderately well but not powerfully executed.
2. He could bend and move the left thigh and leg, but rather feebly. The four movements of the foot were very imperfectly done, more especially 'peronation.' He could flex and adduct the foot moderately well. But he was quite incapable of abducting it, and when he attempted to draw up the foot he merely called into action the extensors of the toes.
3. He had numbness and tingling down the outer side of the left thigh as far as the knee. The sensibility below the knee was materially diminished. That of the right leg was normal. Extremities were cold, especially the left foot.
4. There was occasional slight loss of control over the sphincters.
5. There was some weakness in the left arm, and the grasp of the hand was very feeble.
6. The left leg measured half-an-inch less in circumference at the calf than the right one.
7. The spine was very tender at two parts, viz., at the seventh cervical and at the third lumbar vertebra. The pain was greatly increased on movement, rotation, pressure downwards, but especially on bending backwards.

The treatment prescribed was absolute rest on a surgical couch, and the twenty-fourth of a grain of the perchloride of mercury, with bark twice a day.

Sept. 30th.—Has continued without any material change up to present time. To-day complains of extreme and diffused tenderness about the lower cervical and upper dorsal spines. He shrinks when lightly touched, and starts away from the finger. This tenderness is diffused over the whole breadth of the back, nearly to the lateral median lines,

and occupies a space in length equal to that from the fourth or fifth cervical to the sixth dorsal vertebræ. There is also tenderness to the left of the lumbar spine. He was now seen by Drs. Priestley and Farquharson, as well as by Mr. Myers and myself. We ordered three grains of iodide of potassium in bark, with ammonia, three times a day; belladonna liniment to the back, and absolute rest.

Oct. 7th.—Is much better. Diffused tenderness of back is less. The pain on pressure and movement of the spine the same. Still quite unable to stand. Peronation of the left foot is, however, better performed.

Nov. 4th.—He has slowly improved during the past month. Has taken the iodide of potassium and bark regularly, and been blistered on the nape of the neck and upper dorsal region. To-day he was able to stand, and, with assistance, to walk across the room. The movements of the left foot were nearly normal, and on measurement it was found by Dr. Farquharson and myself that the left leg had regained its natural size. From this time the patient steadily improved. He was sent to the seaside, and in about four months had completely regained his health and strength, and the full use of the left lower extremity.

This case was probably one of concussion of the spine, attended by slight intra-spinal hæmorrhage—the gradual supervention of the symptoms, and their slow subsidence, pointing to this as the pathological state. It is interesting to observe in connection with the nutrition functions of the nerves, that the left leg had decreased half-an-inch in circumference in a fortnight, and that as the paralytic symptoms disappeared it regained its normal girth, although it had not been exercised by any movement—a clear proof that it was lesion of the nerves and not disuse that influenced its nutrition.

Case 7. Fall from Horseback—Concussion of Spine—Immediate Paralysis—Complete Recovery.—Lt.-Col. S—, aged 44, whilst riding at the head of his battalion on Sept. 4, 1872, near Poonah, was thrown from his horse on to a hard road, alighting on his head, without being able to break the fall with his hands. The helmet he wore saved his skull, but through the violence of the concussion with the ground, he was thrown heavily on the flat of his back, in which position he lay completely paralysed as regards motion. He never lost consciousness, nor was in any way stunned. He was immediately seen by Dr. Meadows, who found him to be completely paralysed as to motion but not as to sensation. There was no fracture or other injury of any bone. Staff-Surgeon Giraud, under whose care he subsequently came, states that for the first two or three days after the accident his bladder did not act, the catheter had to be used, and for some three or four weeks he lost flesh and weight rapidly; but from that time he continued slowly but gradually to improve. When first seen by Dr. Giraud, on December 20, the following was his condition:—Incomplete paralysis of motion and of sensation of both upper and lower extremities, most pronounced in the left arm and right leg; numbness and blunted sensibility of the whole of the surface of the body below the neck, more especially in the particular limbs just mentioned, and on the right side of the body. His mental condition was unimpaired, his spirits good. The respiratory and abdominal movements unimpeded, appetite good; he had regained power over his bladder, but his urine was alkaline; the bowels were constipated, and there was a loss of control over the sphincter ani. He had much difficulty in getting from the recumbent to the upright position, and when on his legs could just balance himself, feeling that the least touch would knock him over; he could walk only a few yards with difficulty, his gait being awkward and uncertain; there were no external marks of injury either on the spine or head. On

March 6, 1873, six months after the accident, his convalescence is stated to have been slow and gradual, but uninterrupted. The symptoms just described still remained, though in a much less marked degree. He could stand up and walk about half a mile with confidence; he had increased in weight and put on flesh; his bowels were more regular and more under control; his appearance was good, and his general health and spirits excellent, and as his progress towards recovery had then been going on slowly and uninterruptedly for several months, there was every reason to hope he would ultimately recover. The treatment that was adopted in India consisted of rest, plain and nourishing diet, a liberal allowance of claret or burgundy, plenty of fresh air, and shampooing. Strychnine and moderate doses of quinine and iron were administered, and the bowels regulated by suitable aperients. I saw Col. S— on his arrival in England on the 26th March. He had improved greatly during the voyage, being considerably better in all respects than when he left India. There was no cerebral disturbance, no impairment of any of the senses. He ate and slept well; he had complete control over the sphincter of the bladder, but had not regained power over the sphincter ani. The paralysis chiefly affected the left arm and the right leg: he dragged this leg very remarkably. There was a good deal of rigidity in both these limbs, more especially about the shoulder, and pain on flexing or moving them extensively. The paralysis in the arm chiefly affected the muscles supplied by the musculo-spiral and the circumflex nerves. There was numbness in both the lower extremities, but the right leg and thigh were less sensitive than the left. He complained of numbness in both hands. The spine was tender on pressure and painful on movement in the upper dorsal region. The grasp of the hands was weakened, the pressure on the dynamometer of the right hand indicating 27 lbs., that of the left only 15 lbs. There was very marked hyperæsthesia of the right hand, and, more or less, of the surface of the body generally. If he put the hand into cold water it felt as if it were being scalded. He could not, for the same reason, bear a cold bath, as the skin on the right side of the trunk generally was hyperæsthetic, and cold produced an extremely painful impression upon him. The treatment consisted of rest, but not absolute; iodide of potassium in full doses, with moderate quantities of iron and strychnine. Under this plan he gradually improved, was able to return to India at the expiration of his leave, and is now in the full exercise of his military duties.

Case 8. Compression and Concussion of Cervical Spine, from Blow on Head—Paraplegia—Slow Recovery.—J. S., aged 46, consulted me on December 11, 1868. He was a tall, strong, healthy-looking man. He stated that on hurriedly quitting a steamer between decks at Aspinwall he struck the top of his head violently against the under side of a deck beam, so that it appeared as if he had jammed his head down between his shoulders. He fell forwards on his face, did not lose consciousness, but was instantly aware of being completely paralysed everywhere below the neck. He lost all power except that of speech. The paralysis of motion was complete in all the four limbs. He could not move a finger or toe. He had no uneasy sensations or pain of any kind. He passed water voluntarily, could retain it, and could control the action of the bowels. The accident happened on April 18, 1867. He was carried across the Isthmus of Panama, went on to California, perfectly powerless all the way. He did not suffer at any time from priapism, but he continued to be impotent for more than a year. When he arrived at San Francisco on the 2nd May he was quite powerless, but he soon began to regain some motion in the lower limbs, and in the course of a month was able to walk a little. From this time his walk-

ing power gradually increased, and he began to regain power in his hands, principally in the left. He began to be able to write again in July, but the character of his handwriting was entirely changed. During this period he lost about 20 lbs. in weight, of which he had since regained a considerable portion. There was little treatment adopted except rest. On examination I found the following condition:—The spine was kept straight, had lost its flexibility, and could not be moved without considerable pain. There was tenderness on pressure, and on movement over the first, second, third, and fourth dorsal vertebræ. In pressing on this part of the spine he said that he felt pains shoot down the limbs into his feet. When he walked he felt the jar of the pavement, and suffered much if it was at all irregular. If he attempted to write for any time he was seized with much stiffness and uneasy crampy sensations in his right hand and arm. His general health was good, his pulse quiet. He suffered much from coldness of the extremities. He was put upon a course of the iodide of potassium, under which he rapidly improved.

Case 9. Direct Blow on Back by Fall—Slow Development of Paralytic Symptoms.—J. W., aged 55, consulted me July 18, 1871. Three and a half years ago he met with an accident at New York, falling five feet on his back on to a pile of rough stones. He was not stunned, and no ill effects were felt at the time or for about three months afterwards, during which period he went about his business as usual, being a minister in a Methodist Church. The first symptom he complained of was loss of sleep. He was unable to sleep more than three hours at a time. He then suffered from extreme mental depression, became hypochondriacal and suicidal. He was extremely nervous, so that he could not with comfort be left alone. He then began to walk with difficulty, especially when attempting to go up or down stairs. He suffered some trouble about the bladder, over which he partially lost control. Great tenderness came on in the spine, in the neck and across the loins. He suffered a good deal from numbness and tingling sensations in the left thigh. His feet readily became cold, and his bowels were extremely costive. By rest he improved somewhat. He was advised to go into the country, to be in the open air, and to try gardening. This made him very materially worse. He had increased in weight, being about twelve pounds heavier than he was. When I saw him he was suffering from extreme weakness and constant feeling of exhaustion. There was no energy left; he could do no work, mental or bodily. He slept badly, but better than he did some time ago. He walked slowly and very feebly. He could manage about two miles in the course of the day, always using a stick. He went up or down stairs with great difficulty, and easily tripped. He suffered much from a burning, pricking sensation in the left leg and thigh, but there appeared to be no difference in the strength of the two limbs. There was no affection of the sphincters. His limbs were somewhat wasted. The sight was weak, but it was so before the accident. The spine was extremely tender over the seventh cervical vertebra and the lower lumbar region. There was also some tenderness over the occiput and the sacro-iliac articulation. He was ordered the phosphates of iron, quinine, and strychnine, a generous diet, and complete rest.

Case 10. Direct Blow on Back by Fall Downstairs—Slow Development of Symptoms of Meningeal Irritation and of Paralysis.—Mrs. E., aged 45, consulted me on December 31, 1869. Three and a quarter years previously she fell down eighteen stairs, having at the time her arms full of clothes. Her feet slipped, she fell on her back and bumped down the stairs. She was not stunned, but her back was severely

struck. She got up and walked some distance. She did not keep her bed, and did not think much of the accident, except that she continued from time to time to suffer pain in the lower part of the back. This had continued ever since; she had never been free from it. She complained that her memory was impaired, that she forgot dates; she could not recollect where she placed things, and occasionally she used the wrong word or forgot a particular word she wished to employ when talking. She was apt to lose the thread of her sentence so as to have to begin it again. Her sleep was greatly disturbed by dreams of a terrifying character. There were constant noises in the head, slight deafness of the right ear. Any sudden or loud noise, such as the crying of children or the falling of fire-irons, distressed her extremely. The sight, smell, and taste were unaffected. She suffered much from pain at the back of the neck and across the top of the head. Fatigue and excitement increased this pain very much. Pressure on the spine, rotation and antero-posterior movement occasioned pain over the second and seventh cervical and second and third lumbar vertebrae. The right hand was numb, and she had pricking sensations in the fingers. She had a difficulty in writing and in taking up small objects. The other limbs were free from all uneasy sensations. The hands were cold, the appetite bad, and she had lost flesh considerably. She was ordered bromide of potassium at night, small doses of iron and strychnine in the day, and belladonna embrocation for the back.

Case 11. Concussion of Spine from Direct Violence—Condition of Patient Sixteen Years after Injury.—J. W. A. S., aged 37, from Rhode Island, U. S. A., consulted me on June 29, 1869. He stated that at a fire in June, 1853, sixteen years previously, some bricks fell from a chimney and struck him on his back. He was knocked down by the blow and was laid up for several months. He slowly improved, but continued to be extremely weak in the back, so that although he was able to walk he could not raise himself up if lying in the recumbent position. The left arm was also materially weakened. He had never recovered from the effects of this accident, although he had been able to lead an active, intellectual life, attending very closely to his business. Latterly, however, he had broken down completely in health, and had come to Europe for its recovery. On examining him I found that he complained of his head being heavy, and of a sensation of weight and pressure across the eyebrows, increased by stooping. He dreamed much at night; he was affected by sudden loud noises; his sight was weak; he wore glasses, and suffered a good deal from *muscae volitantes*. The left eye was particularly weak, and there appeared to be some amblyopia. The spine was slightly tender in the middle of the dorsal region. His hands were both numb, but more especially the left one. He suffered a good deal from pricking sensations at the end of the fingers, especially in the left index. He also complained of darting pains in the legs, with sudden spasmodic twitchings, tingling, and uneasy sensations in the feet and toes, with occasional cramps. He suffered a good deal at any attempt at bending up the foot.

Case 12. Slowly Developed Spinal Meningitis, from Direct Injury received in a Railway Collision, terminating eventually in Death.—R. E. M., about 27 years of age, a post-office clerk, was injured in a railway collision on June 23, 1866. At the time of the accident he was standing up in the post-office van. He was violently struck on the right side and loin against the edge of the table in the carriage. He felt giddy, confused, and faint, but did not lose consciousness. For a day or two he was obliged to give up his work, but in the course of a few days was sufficiently recovered to be able to make a journey to Pres-

ton and back. The pain in the back at the part struck gradually increased. He suffered much from tenderness in the spine, in the lumbar region; his health broke down, and he became so much enfeebled as to be obliged to take to his bed. He was seen by Dr. Waller Lewis, and afterwards by Sir James Paget. These gentlemen recognised a severe injury to the structures of the spine at the part struck. He was ordered complete rest, mercurials in small doses, and the application of two or three leeches daily to the spine. This treatment was continued until the end of October, 1866, by which time he had had between 70 and 80 leeches applied with very great relief after each application. The pain, however, returned severely in two or three days if the leechings were discontinued. I saw the patient in consultation with Dr. Lewis on November 3. He was then lying in bed, looked pale, worn, and haggard in face, and appeared to be ten or fifteen years older than he really was. On examining him we found that he was unable to stand without holding to a chair or table. Whilst standing he kept his feet far apart in order to steady himself with a broader basis of support. The muscles of the back on the right side of the lumbar vertebræ were rigid and contracted. He suffered much pain on pressure in the dorsal and lumbar regions of the spine, but particularly about the second or third lumbar vertebra. He complained of pain shooting down the outside of the thighs. The pain in the spine was greatly increased on any exertion or movement, more especially if he attempted to stoop to pick up anything. In doing so he did not bend the spine, but went down upon his knees, keeping the spine straight. He suffered great pain when his shoulders were pressed downwards, and especially if there was any attempt at rotation or at bending backwards. He slept badly, seldom more than half an hour at a time, starting up in terror. Street noises, the shaking of the house by the passage of a heavy waggon, the slam of a door, all jarred and alarmed him greatly. There was no loss of sensation in the legs, but he complained of creeping feelings and of pins and needles. He was ordered the iodide of potassium and bark, absolute rest and good diet. I saw the patient again on February 6, 1867, in consultation with Dr. Lewis, Dr. Webb, and Mr. Holden. He stated that he was no better than at the last visit, and indeed he looked worse. He was wan, pallid, almost livid in the face; his pulse was quick and intermittent about once in every forty beats. There was a good deal of twitching of both arms, but more especially of the right one. His urine had escaped involuntarily on three or four occasions, and he had more than once lost control over the sphincter ani. On examining the spine we found that it was much in the same condition as at the last visit. There was some tenderness in the upper dorsal region; then an absence of pain along the spinous processes; and then extreme tenderness on pressure over the first, second, and third lumbar vertebræ. Movement of any kind or in any direction aggravated his sufferings in these situations very greatly. The muscles of the spine on the right side were very prominent and hard, those on the left soft and flattened, so that a very considerable difference presented itself in the examination of the back on the two sides. He could only walk with difficulty, and with the aid of a stick. He dragged the left foot, which was considerably everted; he could not raise the toes off the ground. On examining the leg we found that the extensor and peroneal muscles were those that were chiefly paralysed. There was a good deal of numbness and loss of sensation over the whole of the left side of the body, but especially in the left leg. These symptoms came on about three weeks previously, and had been gradually increasing. I saw him again in the following June. He had been in the country for some length of time, but

had not improved in health. He was extremely weak and had almost completely lost power in his limbs. The pulse was from 86 to 90, very feeble and intermittent. He could not sleep continuously, owing to frightful dreams. He walked with very great difficulty, leaning on a stick and with his legs widely apart; the left leg was kept straight with the foot everted. He suffered a good deal from cramps in the legs, more especially in the left one, and complained greatly of pain if it was moved away from the side or bent. Latterly he had suffered from sickness and occasional vomiting, twice or thrice in the course of the week. After the conclusion of the legal proceedings connected with the case, I lost sight of the patient, who retired into the country; but Dr. Waller Lewis informed me in 1871 that he had eventually died from the effects of the accident. The particulars of the latter period of his illness and of his death could not be obtained.

Case 13. Severe Contusion—Paraplegia—Unsuspected Laceration of Intervertebral Ligaments—Death on Ninth day.—J. R., a clerk by occupation, was admitted under my care into University College Hospital, October 2, 1862. He had been knocked down half an hour previously by a Hansom cab, the horse falling partly upon him and striking him on the neck with its knee. He never lost consciousness, but being quite unable to move, was carried to the hospital; on his way he passed his urine and fæces involuntarily.

On examination after admission it was found that he had an abrasion and ecchymosis on the left side of the neck. There was no inequality or irregularity about the spinous processes, or any evidence of fracture of the spine, but the patient complained of severe pain at the seat of the bruise. There was complete paralysis of sensation and of motion in the lower extremities and the trunk as high as the shoulders, and incontinence of fæces, retention of urine. The breathing was wholly diaphragmatic. He was quite conscious, and gave a description of the accident. He had suffered from urethral stricture for thirty-three years, so that only a No. 5 catheter could be passed.

On the following day his state was much the same. He complained of great pain in the right arm and hand, which were bruised. He said he thought he was paralysed, as he could not move his legs; but on being pressed to do so, after some difficulty he succeeded in raising both legs, and in crossing them. Sensation appeared to be completely lost. His most distressing sensation was a feeling of tightness as of a cord tied tightly round the abdomen below the umbilicus.

5th.—He had slept well, and was able to move his legs with less difficulty. Pulse 64 strong; passes fæces involuntarily. Urine drawn off, and was ammoniacal. He was placed on a water mattress, as his back was becoming excoriated. Ordered quinine and acids.

8th.—Was able to move his head and neck from side to side. Had less pain. Urine more ammoniacal: fæces passed involuntarily. Bed-sores over sacrum had much extended.

10th.—Difficulty of breathing came on, but was relieved by the 11th. On the 12th it returned, with mucous râles, and he died that night—ten days after the accident.

On examination after death the head and brain were found uninjured and healthy. On exposing the vertebral column, it was found that the sixth and seventh cervical vertebræ had been separated posteriorly. The vertebræ themselves, and their arches, were quite sound, but there was a fissure without any displacement, extending through the articulating processes on the left side. A large quantity of blood was extravasated into the spinal canal, lying between the bones and the dura mater. There was a considerable quantity of reddish serous fluid in the arch-

noid. The pia mater of the cord had some blood patches upon it on the lower cervical region. The cord itself was quite healthy.

In this case it will be observed, that the paralysis was most extensive, as much so as is compatible with life. The loss of sensation appeared to be more complete than that of motion, the patient being able, by an effort of the will, to cross his legs, but he could not feel when they were pinched or pricked. The fracture of an articulation without displacement was an accidental and insignificant complication, the real injury consisting in the extravasation of blood within the vertebral canal, which, by compressing the cord, induced the paralysis, that ultimately proved fatal; death being doubtless hastened by the effusion of a large quantity of serous fluid from the irritated arachnoid.

The primary symptoms of concussion of the cord immediately and directly produced by a severe blow upon the spine will necessarily vary in severity and extent according to the situation of the injury, the force with which it has been inflicted, and the amount of organic lesion that the delicate structure of the cord has sustained by the shock or jar to which it has been subjected.

LECTURE III.

ON THE SYMPTOMS OF SEVERE CONCUSSION OF THE SPINE FROM DIRECT VIOLENCE.

THE effects of a direct blow on the spine, producing concussion of the spinal cord, will necessarily vary very greatly according to the part that is struck.

It is quite possible to suppose that a direct blow on the cervical spine may give rise to instantaneous death without dislocation or fracture of the column. But it is very important to bear in mind that a fracture or even partial dislocation may exist unsuspected—the case being considered one of simple contusion—and that after a few hours or days a suddenly fatal result may occur from pressure of the cord above the fourth cervical vertebra, from change in the displacement. The two following cases illustrate the fact.

Case 14. Severe Contusion—Slight Paralysis—Unsuspected Dislocation between the Second and Third Vertebrae—Sudden Death on Fourth Day.—W. W., aged 34, a carpenter, was admitted into University College Hospital, May 16, for injuries sustained while getting out of a train before it had stopped, by falling between the platform and the carriages. When picked up he was sensible, and complained of pain in his right arm; and it was noticed that he had had a motion.

On admission he was found in the following condition:—There was an incised wound on the left side of the head, a hæmatoma of the left upper eyelid, and a fracture of the right clavicle at the junction of its middle and outer thirds. There was also extensive bruising of the upper two-thirds of the right arm; and, on palpation, the fingers could easily be placed all round the shaft of the humerus just above the insertion of the deltoid, the skin only intervening. The left deltoid was paralysed, and the power of supinating the left hand was impaired. There was no local bruising about the left shoulder to account for this paralysis, nor was there any pain on passive movement. There was a line of bruising running across the chest from the right axilla to the left side of the sternum, at the level of the second and third ribs. All

the movements of the lower extremities were perfect, and the patient had complete control over his bladder. When sitting up, he complained of pain in his neck, which was relieved by supporting the right arm. He was put to bed flat on his back, the head was steadied by sand-bags, and the right arm was placed in a sling.

May 17.—Very thirsty during the night; did not sleep. 11 A.M.: Temperature 100.8° F.; pulse 120; sweating profusely. 11.30 P.M.: Pulse 132; sweating profusely; slept after twenty grains of chloral hydrate.

18th.—Thirst still continues. 10 A.M.: Temperature 100.4°; pulse 120; respiration 36. 6.10 P.M.: Temperature 101°; pulse 124; respiration 36. During the night he was very restless, kicking off the bed-clothes; did not sleep after twenty grains of chloral hydrate, nor after a draught containing twenty grains of bromide of potassium and twenty drops of tincture of hyoscyamus.

19th.—1 A.M.: Respiration hurried. Patient very restless; answers rationally when spoken to; does not complain of pain anywhere. 10.30 A.M.: He got very little sleep last night. Face and finger-nails dusky; alæ nasi working; respiration 44; pulse 96; sweat standing in drops on his face; mucus rattles in the throat. He complained greatly of his head being so low; he was then raised up into a half-sitting posture, and supported there with a bed-rest. He said he felt much better and more comfortable, when all of a sudden his pulse at the wrist stopped, his head fell forwards and to the right side, his breathing stopped, and he was apparently dead. The bed-rest was at once removed, an ounce of brandy was given by the rectum, and artificial respiration was begun. The conjunctiva was insensible to touch; pupils equal, small, and insensible to light. In a short space of time he began to breathe in a short, catching way. The pulse returned, and the conjunctiva became sensitive; pupils reacted to light, and finally he was completely restored to consciousness and was apparently as well as he was before. In a few minutes he began struggling and kicking his legs about with great violence; he soon became quiet, and asked where he was, and, when told, was satisfied. Three minutes later he was evidently dead. Artificial respiration was again resorted to, and brandy given by the rectum, but without success.

Autopsy.—The second, third, and fourth ribs on the right side were broken at their points of greatest convexity. The greater part of the lower lobe in each lung was collapsed. There was an ante-mortem clot in the right auricular appendix. No injury to any of the abdominal viscera. There was no fracture of the skull, but a slight recent hæmorrhage was found beneath the parietal layer of the arachnoid; brain healthy. On removing the trachea and œsophagus, very extensive extravasation was found in the loose cellular tissue behind them, and a dislocation of the cervical spine between the second and third vertebræ, the greater part of the intervertebral cartilage being adherent to the third vertebra. The ligamentous structures were more lacerated on the left than on the right side, so that while lateral displacement of the upper part of the spine to the right was possible, that to the left was not much more than natural; excessive displacement in the antero-posterior direction easily occurred, and in either case, but especially when moved forwards, there was pressure on the cord. In the right upper extremity the biceps and brachialis anticus muscles were torn across without the humerus being broken, and the clavicle was broken at the junction of the outer and middle thirds.

The interesting points in this case were:—1. That on admission he evinced no sign of head injury, nor of paralysis generally; but in the

left upper extremity he had lost power over the deltoid and supinator muscles. 2. That there was a dislocation between the second and third cervical vertebræ. 3. That the man lived so long, a point of great medico-legal interest, because it shows that such an injury may be survived. On visiting him I came to the conclusion that he had sustained an injury to the cord in the cervical region, and that this was the cause of the paralysis of a portion of the brachial plexus, the circumflex and the musculo-spiral being the nerves that were paralysed. This clearly pointed to a central origin, which could only be at the spinal cord. I did not diagnose, nor even suspect, the peculiar injury of which he died, because it is very rare and of very unusual character. The head and two first cervical vertebræ were dislocated from the third cervical vertebra, and the dislocation was complete, the articulating processes being unbroken. But the same may happen when a cervical vertebra is broken but not displaced.

Case 15. Unsuspected Fracture of Spinous process of fifth Cervical Vertebra—Displacement and Sudden Death.—A woman was admitted into University College Hospital suffering from the effects of a fall on the back, the circumstances attending which were obscure. There was no head injury or head symptoms and no paralysis. But she complained of pain in the neck, and kept the head fixed immovably, being quite unable to turn it to either side. A few days after admission, whilst sitting up in bed, she was startled by a noise in the ward, turned her head suddenly to see what had occasioned it, and fell back dead.

At the autopsy it was found that the spinous process of the fifth cervical vertebra had been broken off at its root. In the sudden movement it had got jammed into the space between the arches of that and the contiguous vertebra, compressed the cord, and produced sudden death.

These two cases are important from a medico-legal point of view, as showing that notwithstanding the infliction of an injury of a fatal character, life may be prolonged for several days until death is brought about by an accidental movement.

Injury to the spine that is by its very nature fatal may occur without any direct blow on the spine itself, but from falls on the head. Thus I have seen a case in which a man fell on his vertex out of a window. There was extravasation under the scalp, but no fracture of the skull. The only sign of nerve injury was paralysis of the spinal accessory. Paralytic symptoms gradually invaded the limbs. First one upper extremity, then the other became paralysed, and then one leg. After death the atlas was found broken through its left lateral mass, and the cervical portion of the cord had undergone inflammatory softening and central disintegration.

But if the injury or concussion of the cervical spine be not immediately or speedily fatal, it may lead to more or less complete paralysis of the body generally, or of the upper extremities only.

The paralysis may be hemiplegic. But most commonly it affects the arm and leg on one side, and the leg to a limited extent on the opposite one, or there may be more or less distinct paraplegia. In injuries of the cervical spine, more or less paralysis and spasm is apt to be developed in the muscles of the neck and of one arm; the leg often being but very slightly if at all affected. There is in fact every possible variety, in the extent, degree, and relative amount of paralysis of motion and of sensation.

Injuries of the back below the cervical region, unattended by fracture or dislocation of the spine, are scarcely ever immediately and not very frequently remotely fatal. But they are apt speedily to give rise to and remotely to be followed by a long train of more distressing symptoms.

The condition that is most frequently developed by a direct blow on the middle or lower dorsal, the lumbar or lumbo-sacral regions, is that of paraplegia.

The symptoms presented by the patient who is thus paralysed below the seat of the concussion of the spine are necessarily those which result from such a disturbance, commotion, or lesion of the cord as will occasion serious modification or complete suspension of its functions.

In these primary and more immediate forms these symptoms are of the following kinds:—

1. Diminution or loss of motor power.
2. Rigidity and spasm of muscles.
3. Diminution or loss of sensation.
4. Perversion of sensation.
5. Loss of control over the sphincters.
6. Modification of the temperature of the limb.

1. Diminution or loss of motor power is usually the most obvious and marked symptom.

It may be complete, so that the patient is quite unable to stand; or it may be limited, affecting only certain sets of muscles, and that to a comparatively slight degree, so as to require careful examination to determine the existence of any loss of motor power.

It may affect the two limbs equally or in unequal degrees. It may be confined entirely to one limb.

In all cases, when slight, the loss of power is most marked when the patient stands, walks, or attempts to run. When the patient is recumbent he will, though suffering seriously from immobility, yet be able to draw up his legs, kick them out, and appear to possess complete control over them. But these movements come from the thigh and knee, and not from the leg and foot.

When the paralytic immobility is complete or nearly so, there is necessarily no difficulty in determining its existence. But when the loss of power is slight, and especially if it do not affect the limb generally, but is confined to one set of muscles, it becomes more difficult to determine its existence.

In these circumstances it will be necessary to test the patient's motor powers more carefully. This may be done by telling him to walk, run, stand on one leg, or go up and down stairs, when the failure in power in one or both limbs will usually at once declare itself. He totters and straddles his legs, so as to increase his basis of support, and he drags one foot, being unable to raise the toe fairly from the ground.

In order to determine the precise set of muscles that are affected, we have two tests, viz., loss of voluntary motion, and the determination of the loss or diminution of the electric irritability of the muscles.

Any one of the muscles connected with the lower limbs may be affected.

In some cases the psoas muscles, and apparently they only, are paralysed. When this is the case the patient, when once erect, can stand and walk fairly well; but when sitting he cannot rise off his chair without the uplifting use of his arms. If told to rise without assisting himself with his hands or with a stick, his contortions are most painful to witness. He writhes about in the chair, presses the ground with his feet, raises his legs, bends backwards and forwards, but appears to be immovably fixed in his seat by the buttocks. If given a hand or aided with a stick, he rises readily and stands and walks well. When lying flat on his back he cannot raise the extended limb off the couch. He

can bend the knee, and thus draw up the leg, but he cannot extend and then raise it.

I have never met with a case in which the paralysis could be localised in and was confined to the muscles of the thigh. In all cases where the anterior crural and obturator nerves were affected the whole of the lumbosacral plexus seemed to have participated in the paralytic condition.

But it very frequently happens that the muscles of the leg and foot are affected without any of those above the knee participating in the loss of power.

The loss of power below the knee may be complete or it may be confined to one or other of the sets of muscles that move the foot. When complete there is no difficulty in determining its existence. It is when incomplete that it is sometimes difficult to determine the degree of the paralysis and its precise seat.

In order to ascertain whether there is motor paralysis or not, it must be borne in mind that the foot is capable of four distinct movements at the ankle-joint; viz., 1. The heel may be raised and the toes pointed downwards. 2. The foot may be turned inwards—both these movements, I need not tell you, are affected by the muscles supplied by the internal popliteal nerve. 3. The heel may be depressed and the toes raised. 4. The foot may be turned outwards. These two latter movements are effected by the muscles supplied by the external popliteal or peroneal nerves.

Now the readiest means of determining the extent and the seat of the motor paralysis in the leg is to place the patient on his back, to extend his leg, and then to steady the knee by grasping it in one hand so that he may not turn the limb involuntarily. Next direct him to point his toes, then to turn the foot inwards, then to draw up his toes, and lastly to turn the foot outwards. He will either be able to execute all the movements in an imperfect degree—the amount of imperfection depending on the extent of the paralysis—or he will be able to do the two first, which are under the control of the internal popliteal nerve, but not the two last, which are under the direction of the peroneal nerve. It is a remarkable fact that, in the large number of cases in which I have made the experiment, I have never met with one in which power is lost over the muscles supplied by the internal popliteal nerve whilst it still remained in those supplied by the peroneal nerve. On the other hand, the number of instances in which loss of power existed in the muscles supplied by branches of the external popliteal nerve, the depressors and adductors of the foot retaining their full mobility, has been very great.

It will generally be found that the movement which is first lost in cases of injury, and last regained in cases of recovery, is that of eversion of the foot, the action of the peronei muscles. Next to this the action that is most readily impaired is that which is under the control of the elevators of the foot, viz., the depression of the heel and the raising of the foot as a whole—not of the toes only—for that power will exist when the other is lost.

It is in consequence of the frequency of the paralysis of the external popliteal nerve in cases of slight paraplegia that the patient in walking drags the toes, and usually turns them inwards. He is unable to raise the foot so as to clear the ground, or to evert it properly. Hence the sole of his boot will be found worn away at the toes and not at the heel, and more at the inner than at the outer side.

The two limbs may be affected in this way as nearly as possible to the same extent. When one limb is more paralysed than the other, I have found it to be most frequently the left. In many cases it alone is affected, the right leg escaping entirely.

I have never seen opposite sets of muscles affected in the two limbs. If both limbs are paralysed, the same sets of muscles are always involved, though in varying degrees of intensity.

Jaccoud¹ truly says, 'In every disease of the nervous system, and of the muscular system, the clinical examination is not complete until the electric investigation has been effected.'

The electric test when properly applied will enable us to determine not only diminution or complete loss of the irritability of the muscles that refuse to obey the volition of the patient, but also the varying extent to which the loss has proceeded on the two sides. In employing this test it is important always to compare the irritability of the same muscles in the opposite limbs—never to compare the irritability of a flexor with that of an extensor in the same limb, and above all not to compare the irritability of the muscles of a lower and an upper extremity. The irritability is as a rule greater in the latter than in the former.

It is important to bear in mind that in elderly persons the electric irritability of the muscles, especially of the lower limbs, is often considerably diminished without there having been any diminution or impairment of innervation from injury.

2. Rigidity, with more or less permanent spasm and contraction of certain muscles, is frequently met with in cases of spinal injury. It is often associated with hyperæsthesia. The muscles that are most commonly affected in this way are the flexors of the limbs. The extensors, as we have seen, are most commonly palsied, the flexors most frequently rigid and often contracted. Next in frequency to the flexors of the limbs rigidity affects the trapezius and sterno-mastoid—the muscles about the shoulders, and the large lateral masses of spinal muscles. These will frequently be seen to be rigid, tense, and thrown out in prominent relief, partly in consequence of irritation of the nerves supplying them, partly also in a reflex or instinctive manner, in order to protect neighbouring or subjacent tender parts. This condition of the muscles is usually associated with much pain, even though it be not of the nature of cutaneous hyperæsthesia; and the pain is greatly increased in any attempt at stretching or moving the affected muscles. Rigidity and painful muscular contraction may be looked upon as indicative of meningeal rather than of medullary lesion.

3. Diminution or loss of sensation probably does not occur so frequently or to the same extent as impairment of motor power. When it does exist to a slight or limited degree it is more difficult of determination than the loss of free motion.

Like paralysis of motion, anæsthesia may be general or partial below the seat of injury to the spine. It may be confined to one nerve, or even to its cutaneous branch. When this is the case, it is most usually the cutaneous filaments of the external popliteal that are affected.

The extent and the precise area of the impairment of sensation may readily be determined by means of the æsthesiometer of Brown-Séquard, or an ordinary pair of compasses—to measure the limit of the perception of the two points—by the interrupted electric current, or by pulling the hairs in the wrong direction.

4. Pain and perverted sensations of all kinds are very common in cases of spinal concussion from direct blows on the back. As I have already stated, the pain is more frequently associated with

¹ *Clinique Médicale*, p. 339.

muscular contraction and rigidity than with palsy. But it may be associated with a paralytic state, and thus the combination of neuralgia and paralysis of some muscles, with more or less rigidity of others, becomes as painful for the patient to bear as it is difficult for the surgeon to explain.

Hyperæsthesia of the most intense character is frequently found associated with anæsthesia. In these cases the hyperæsthesia extends in a line between the parts that preserve their normal sensibility and those that are anæsthetic. Thus in cases of dorsal injury of the spine, there may be a hyperæsthetic zone round the body, with more or less complete anæsthesia of the pelvis and lower limbs. In injury of the cervical spine, there may be a hyperæsthetic line extending down the arms, the skin on one side of the limb above the line being normally sensitive, that on the other side being completely benumbed. This thoracic or abdominal zone round the body, or perpendicular line of hyperæsthesia down a limb, corresponds to the distribution of the nerves that are given off from the spinal cord at the seat of injury. This may as a rule be taken as an indication of fracture across the vertebral column, even though there be no displacement of the bones. It is occasioned by the irritation of the nervous trunks by the sharp or ragged edges of the fractured portions of bones, in their passage through the injured portion of the spine.

There is a minor degree of this form of hyperæsthesia, consisting of the sensation of a cord tied tightly round the body, which is very common in severe blows, more especially in wrenches of the spine, and which seems to be dependent rather on pressure on the nerves by ligamentous strain than by bony fracture. The following case which has been under my care at University College Hospital is a good illustration of this form of hyperæsthesia:—

Case 16. Injury of the Spine in lower Dorsal Region—Recovery with angular Curvature.—About 10.30 p.m. on June 28th, a blacksmith, aged 23, was seated on the top of a pleasure-van, when the driver attempted to pass under a low archway leading into a mews. The patient stooped forwards, the edge of the arch struck the lower part of his back, and he was thus dragged through the archway, forcibly doubled up and crushed between it and the top of the van. He felt at once great difficulty in breathing, and was brought to the hospital. When seen, a few minutes after the accident, the patient was suffering from great dyspnoea; the breathing was almost entirely thoracic; the rectum had been emptied involuntarily. The left leg was paralysed, and there was intense hyperæsthesia over the lower part of the thorax and back, *i.e.*, below the level of the third costal cartilage, as well as over the abdomen and the upper two-thirds of the thighs. Even slight pressure on any part of this area caused intense pain, and firm pressure still more. Above and below the limits mentioned, sensibility was apparently normal. Opposite the spines of the tenth, eleventh, and twelfth dorsal vertebræ there was a considerable prominence, which terminated abruptly below in a depression. Ice-bags were ordered to be applied to the spine.

June 29th.—There was still dyspnoea, but the patient could draw up the left leg in bed and move the toes. The hyperæsthesia was mucosely the same as on admission. The patient had control over his bladder; there was no priapism.

June 30th.—On more careful examination, the limits of the hyperæsthesia were as follows. On the front of the left leg, it extended to

three inches below the knee; on the right, to the upper border of the patella; posteriorly, it extended to the middle of the thigh in both limbs; above, it began at the lower border of the ribs. The patient's breathing was rather easier. He still complained of the sensation of having a band tied round the abdomen.

July 1st.—Since 3 A.M. the patient has had painful twitchings of the muscles of the left thigh, especially of those in front, and the symptom was becoming more troublesome. The hyperæsthesia does not extend so high as yesterday, only to the level of the iliac crests.

July 2nd.—Pulse 60, soft and regular; respirations, 24; temperature, 99°. The patient was decidedly better. The hyperæsthesia reached from the level of the iliac crests to the upper border of the patella in the left leg, and to the junction of the middle and lower third of the thigh in the right. The twitching of the left thigh was less. The patient could not raise either foot from the bed, but, in attempting to do so, the right rectus femoris muscle contracted more strongly than the left.

July 3rd.—The area of hyperæsthesia had again diminished, the difference being greater below than above.

July 8th.—The hyperæsthesia was now limited to the pubes and scrotum. The patient still had the feeling of a tight band round the abdomen, but it was less marked than it had been before, and was felt at a lower level. His general health was improving.

July 16th.—The hyperæsthesia was now confined to the scrotum, and chiefly to the left side. The sensation of the band round the body had quite disappeared.

July 30th.—For the last few days, the patient had been up and about the ward daily. He stooped much when standing or walking, the shoulders being rounded and thrown forwards. There was some angular curvature of the spine, the ninth dorsal vertebra standing out most prominently. The patient was discharged convalescent.

Whether there was in this case actual fracture of the spine, or partial dislocation with laceration of ligaments, or both combined, could not be stated with certainty; but there was considerable contusion of the spinal cord—the motor tract being slightly, the sensory more severely injured. The distribution of the symptoms, and the order in which they disappeared, was interesting.

Various perversions of sensibility are met with. Formications, tinglings, cramps, 'pins and needles,' are all sensations that are commonly referred to the parts below the seat of spinal concussion. They will frequently be adverted to and described in the following pages, but need only be mentioned here. There is one peculiar perversion of sensation which I have several times observed in cases of paraplegia. It is this that whilst the legs are lying straight and parallel to one another the patient feels as if they were crossed over one another at the knees, and asks to have them straightened.

The results that are afforded by clinical observation as to the greater frequency of loss of motor power than of sensation in cases of concussion of the spine from direct blows on the back are explained and supported by the physiological investigations and discoveries of Brown-Séquard. This distinguished physiologist has shown that the motor fibres run on the exterior of the cord in its antero-lateral columns, crossing at the pyramids, whilst the sensory fibres are situated deeply in the cord running to the grey matter and crossing at once to the opposite side. The motor fibres then being most superficial, and consequently more exposed, will be injured by accident or affected by disease more readily than the more deeply-seated sensory fibres. If the injury to the cord

be slight, or if the disease be superficial, affecting the meninges chiefly and only implicating the mere exterior layers of the medulla, motor power will alone be impaired; whereas if the grey matter is implicated in the injury or disease, sensation will be more or less completely lost, according to the depth and extent of the implication. And if the grey matter on only one side of the cord be affected the loss of sensibility will, owing to the crossing of the fibres, occur on the opposite side. This explains what we have such frequent opportunities of observing in those cases of spinal concussion, namely, that motion may alone be impaired, that it is affected to a greater degree than sensation, and that sensation may be diminished in the limb opposite to that in which motion is lost. It is also possible to conceive that in consequence of intra-spinal hæmorrhage destroying or compressing the grey matter alone, sensation might be abolished whilst motor power remained intact.

This has actually been observed in some cases both of injury and disease.

The various combinations of motor paralysis, anæsthesia, and hyperæsthesia, which are often met with in cases of concussion or other injury of the cord, may be explained by the results of the experimental researches of Brown-Séquard, who has found that in lesion of one-half of the spinal cord, its transverse semi-section for example, there will be paralysis of motion with hyperæsthesia of the injured side and anæsthesia of the opposite side of the body. If the posterior columns be divided there will be neuralgia with motor ataxy, and a lesion of the lateral columns will produce paralysis with contracture (Seguin). It is by reference to the results of experimental researches that we are thus enabled to account for clinical phenomena that would otherwise be utterly inexplicable, or that might be considered incorrectly described by the patient or inaccurately observed by the surgeon.

5. Paralysis of the sphincters of the bladder and rectum is an extremely uncertain symptom. It is sometimes met with in comparatively slight cases, especially when the blow leading to the concussion has been inflicted low down, in the lumbar and sacral regions. It is sometimes absent when both the lower limbs are completely paralysed. If, however, the seat of concussion be about the middle dorsal vertebræ, and if the injury be severe, it is always present to a greater or less degree.

The paralysis may be confined to the bladder only. In these cases there may be complete atony with incontinence, or there may be retention with or without overflow of the urine.

There would appear to be two forms of paralysis of the bladder in spinal injuries. In one there is a contracted, in the other a dilated state of the organ. In the first or contracted form the bladder appears to be collapsed, there is complete incontinence, the bladder allowing the urine to flow out by the urethra as soon almost as it is brought in by the ureters, no urine is retained. If a catheter is introduced the viscus will be found to be empty, or nearly so. In these cases the urine continues acid, often markedly loaded with uric acid, as Ollivier has remarked. In the other form of paralysis there is partial or complete retention. The bladder falls into a state of atony, becomes dilated by the gradual accumulation of the urine which it is unable to expel. At last the overflow will dribble away as in ordinary senile atony of the bladder. In these cases there is a great tendency to alkalinity, owing to the development of sub-acute cystitis. It is the kind of paralysis that is most common in the more severe forms of spinal concussion and lesion. It would appear as if in these cases the sensibility of the bladder was lost, and that the stimulus of the accumulated urine was not felt in a sufficient degree to develop the requisite reflex expulsive action.

The condition of the bowels closely resembles that of the bladder. In some cases there is relaxation of the sphincterani, and the peristaltic action being free, a kind of spurious diarrhoea sets in. But more commonly in cases of spinal concussion the bowels are confined, owing apparently to a want of extrusive action in the abdominal muscles as well as to impaired peristaltic motion.

Priapism does not occur in concussion as it does after laceration and irritation of the cord. Indeed, as a rule, the genitals are very flaccid, and the venereal desire as well as power is lost.

6. The temperature of the body generally, but more especially of the extremities, is found to undergo important modifications in injuries of the spinal cord. It may fall below or rise materially above the normal point. The fall or rise will depend upon the nature of the injury as well as on the part of the spine that is the seat of injury.

In spinal concussion there is as a rule a fall of temperature. In laceration or crush of the spinal cord, consequent on fracture of a vertebra, there is often a rise—the more so if the cervical spine is the seat of injury.

The temperature in cases of spinal concussion may fall and remain for many weeks or months below normal point. It is not very easy to arrive at a true estimate of low temperatures. The high are positive facts and easily observed, but the low are rather of a negative character, and may easily escape detection or may not so readily be determined or may be ascribed to imperfect or faulty observation rather than to actual existence. I have however seen unequivocal instances of continued low temperatures of the body in the mouth and axilla, in cases of spinal concussion, as low as 92° to 93° F. and continuing for many months from 2° to 3° F. below normal. But the temperature may fall lower than this in a more serious injury of the cord. Thus Dr. Nieden relates a case¹ in which after dislocation of the first dorsal vertebra, with crush of the cord at the seat of injury and much meningeal ecchymosis, the temperature fell to 81° F., from which it progressively sank, the patient dying on the eleventh day with a temperature of 80°·6 F.

More commonly the low temperature is confined to the extremities, especially the feet, which are sensibly colder than other parts of the body. Often the feet are as low as from 80° to 85° F., and will remain so for very long periods of time.

The two feet and even the two axillæ, although both below normal point as to temperature may be unequally so by several degrees, 2°, 3°, or more. A continuous depression of temperature on one side of the body may be the fore-runner of hemiplegia, and any way is often connected with a loss of innervation that amounts to loss of power, though not perhaps to actual paralysis, as evidenced by diminished power in the grasp of the hand, or impaired motility of the foot.

I have never met with a high temperature in cases of spinal concussion unless occasioned by inflammatory complications of an obvious character. It is well known however that in primary injury of the cord in the cervical region the temperature of the body will often rise very considerably shortly before death. Brodie, who first observed this fact, noticed that in one case it rose to 111° F. And since his time this observation has been verified by most surgeons. The highest temperatures noted in these cases however have been under 112° F. and a persistently higher temperature was scarcely supposed to be consistent with the continuance of life, until the case recently related to the Clinical Society by Mr. J. W. Teale² with so much circumstantiality of detail and so much accu-

¹ *Clinical Society's Transactions*, 1873.

² *Ib.*, Feb. 28, 1875.

racy of observation as to leave no doubt as to the complete trustworthiness of the facts, astounding as they are, and subversive of all previous experience on the subject. In this remarkable case the patient, a young lady, sustained a severe but obscure injury of the spine by her horse falling in taking a gate and rolling upon her. She recovered after a lengthened illness, during sixty days of which the temperature ranged from 105° to 120° and even 122° F.

It is not my intention at present to enter into a description of the symptoms that result from the secondary and more remote effects of blows on the spine, and of concussion of the cord. All this I shall reserve for a later lecture. It will suffice for me to say that these symptoms are usually occasioned by the development of inflammation of the meninges and of the cord itself. They consist of pain in some part or parts of the spine, greatly increased by pressure and motion, associated with reflex rigidity of the muscles of the back, the patient moving the vertebral column as a whole. The pain is greatly increased by all movements, but especially by those of rotation.

Pain frequently extends down the limbs or round the body, giving the sensation of a cord tied tightly.

If the case go on to the development of acute inflammatory action in the cord and its membranes, cramps and spasms of a serious character occur—at first, usually of the nature of trismus—then general spasms of the body and limbs of a tetanic character, often followed by speedy death from the exhaustion produced by the repetition of these violent convulsive movements.

If the inflammatory action assume a chronic and subacute character, permanent alterations in the structure of the cord will ensue, which will lead to much local pain and tenderness in the spine itself, to neuralgic cramps in the limbs, and eventually to paralytic affections of an incurable nature, usually confined to the lower extremities, with symptoms indicative of the extension of the inflammatory mischief to the cerebral meninges or to the brain, and associated with great and radical derangement of the general health.

Concussion of the spine from a direct and severe injury of the back may terminate in one of four ways:—1. In complete recovery after a longer or shorter time; 2. In incomplete recovery; 3. In permanent disease of the cord and its membranes; and, 4. In death.

The probability of the termination in recovery does not depend so much on the actual severity of the immediate symptoms that may have been occasioned by the accident as on their persistence. If they continue beyond a certain time, changes will take place in the cord and its membranes which are incompatible with the proper exercise of their functions.

Concussion of the spinal cord from a severe and direct blow upon the back may prove fatal at very different periods after the injury. The time at which death occurs will depend partly on the situation of the blow, but in a great measure on the lesions to which it has given rise.

Concussion of the spinal cord may, and often has, proved fatal by the sudden induction of paralysis, though no lesion sufficient to explain the fatal termination of the case be found after death.

In this respect it resembles concussion of the brain. But it is probable that it might be found in a fatal spinal concussion, that the nervous substance is widely and profusely studded with disseminated punctiform blood extravasations, as I have observed in fatal cerebral concussion.

Abercrombie says, 'Concussion of the cord may be speedily fatal without producing any morbid appearance that can be detected on dissection.' And he refers to the case related by Boyer, and to four cases recorded by Frank in confirmation of this remark.

But in other cases the fatal result may have been occasioned by direct and demonstrable lesion of the cord.

There appear to be four forms of lesion that will lead to a fatal result in cases of spinal concussion.

1. Hæmorrhage within the spinal canal.
2. Laceration of the membranes of the cord, and extrusion of the medullary substance into the spinal canal.
3. Extravasation into the substance of the cord.
4. Disintegration and perhaps inflammatory softening of the cord.

1. Hæmorrhage within the spinal canal may occur:

- 1st. Between the vertebræ and the dura mater.
- 2nd. Between the membranes and the cord.
- 3rd. In both situations.

In these respects intravertebral extravasations resemble closely those that occur as the result of injury within the cranium. The three following cases are illustrations of these three forms of hæmorachis.

Sir A. Cooper mentions one case, to which I shall have occasion hereafter to refer, in which, in consequence of a strain of the neck in a boy aged twelve, symptoms of paralysis slowly supervened, which proved fatal at the end of a twelvemonth.

On examination after death, 'the theca vertebralis was found overflowing with blood, which was effused between it and the inclosing canals of bone.' This extravasation extended from the first cervical to the first dorsal vertebra.

Müller¹ relates the case of a corporal of Cuirassiers who fell from a hay-loft on to his back, striking it against a log of wood. He was found to be completely paralysed in his lower limbs, but preserved his consciousness. He died on the second day. On examination it was found that there was a large quantity of blood extravasated between the spinal cord and its membranes. This extravasation extended from the sixth cervical to the ninth dorsal vertebra.

Ollivier² relates the case of a woman, aged 49, who threw herself out of a window in the fourth story, alighting on her back. There was complete paralysis of the lower limbs, with incontinence of urine. Her mental faculties were unimpaired. She died on the third day after the injury, and on examination it was found that there was a fracture, but without any displacement, of the tenth dorsal vertebra; at this spot blood was extravasated between the vertebra and the dura mater, and also into the subarachnoid cellular tissue.

2. Death may occur—in that form of severe concussion which we are at present considering—from laceration of the pia mater, and consequent hernia of the cord. Of this form of fatal result, Ollivier records one case, that of a man, aged 46, who had fallen heavily on his back, striking the spine in the middle of the dorsal region. He had paraplegia, loss of power in the sphincters, violent pain in the spine at the seat of injury, and much constitutional disturbance. He died on the seventeenth day. On examination after death it was found that the pia mater of the cord had been ruptured at two places opposite to the seat of injury, giving exit to the medullary substance in two patches, each about the size of a halfpenny, about two or three lines in thickness, and of a reddish colour. These protrusions had passed out of two longitudinal

¹ *Bull. des Sc. Médicales*, 1826.

² Vol. i. p. 492.

slits in the meninges of the cord, each about one inch in length, situated at the medial and posterior part, and opposite to the fourth and fifth dorsal vertebræ. At the points opposite to these hernial protrusions, the spinal cord was much contracted, having lost a great part of its substance; but it preserved its normal consistence. The dura mater contained a large quantity of bloody serum.

3. Extravasation into the substance of the spinal cord is undoubtedly a rare lesion, but that it may occur as the result of injury there can be no doubt. In many of the cases in which sensation is more affected than motion or in which the principal lesion consists in a modification of sensation, coming on immediately after the receipt of a blow on the back, there may be reason to suspect laceration of the grey matter with extravasation of blood into it. Hammond¹ mentions two cases in which incurable paraplegia followed supposed spinal hæmorrhage. Speedy death, however, most usually occurs as a consequence of such an injury.

4. The last condition of the cord that leads to a fatal termination in these cases of concussion arising from direct and severe injury is inflammation, with, perhaps, suppuration of the meninges, followed by inflammatory softening and disintegration of its substance. This is, doubtless, of an acute and probably inflammatory character. The following cases will illustrate this morbid state.

Ollivier relates the case of a man, aged 28, who fell from the second story of a house, striking himself violently on his back, left hip, and thigh. His lower extremities became paralysed completely, as far as motion was concerned; incompletely, as to sensation. The sphincters were paralysed. He died on the thirtieth day after the accident. On examination after death, it was found that the spinous process of the fourth cervical vertebra was detached but not displaced, and the twelfth dorsal vertebra was broken across but not displaced. The spinal cord was healthy in all parts except opposite this point, where it was soft, diffuent, of a yellowish-grey colour, and injected with capillary vessels.

A remarkable case is recorded by Sir C. Bell.² It is that of a waggoner who was pitched off the shafts of his cart on to the ground, falling on his neck and shoulders. At this part there was evidence of bruising. He could not stand, and dragged his legs. He lay for nearly a week without complaint, and had during this time no sign of paralysis. But on the eighth day he was suddenly seized with convulsions over the whole of the body—which were relieved by bleeding. He became maniacal, but in the course of twelve hours the convulsions ceased and he was again tractable. On the third day after this attack he complained of difficulty in using his arm, and on the fifth day he had total palsy of the lower extremities, regaining the use of his arm. He died about a week after this. On examination after death, it was found that a considerable space existed between the last cervical and the first dorsal vertebræ. The intervertebral substance was completely destroyed, and an immense quantity of pus surrounded the bones. This purulent collection had dropped down through the whole length of the sheath of the cord to the cauda equina.

The following case offers a remarkable resemblance to the preceding one—being attended by nearly identical post-mortem appearances following the same kind of injury.

Dr. Mayes,³ of Sumter District, South Carolina, relates the case of a negro who, while raccoon-hunting, fell a height of fifteen feet from a

¹ *Diseases of the Nervous System*, New York, 1873, p. 440.

² *Op. Cit.* p. 145.

³ *Southern Medical and Surgical Journal*, 1847.

tree, striking his back at the lower cervical and upper dorsal regions against the ground. He instantly became completely paraplegic, and died on the tenth day. On examination seven hours after death, it was found that the fifth and sixth cervical vertebræ were separated from each other posteriorly, but not fractured or dislocated. Here there was manifest injury to the medulla. As soon as the muscular coverings of the spine were cut through, the softened and disintegrated medulla gushed out 'similar to the escape of matter from an abscess when opened by the lancet. The medulla spinalis was evidently at this point in a state of decomposition.'

In this case it is evident that not only the meninges of the cord, but the ligamenta subflava were torn through, and the arches of the vertebræ separated to such an extent that the softened and disorganized medulla found a ready exit through the gap thus made at the posterior part of the spinal column.

It is a point of much practical moment to observe that in this, as in several other of the cases of so-called 'concussion of the spine,' there is, in addition to the lesion of the cord, some serious injury inflicted on the ligamentous and bony structures that enter into the composition of the vertebral column, which, however, must be considered as an accidental complication, as it does not occasion, or even seriously aggravate, the mischief done to the medulla itself. Thus the ligaments, as in the case just related, may be torn through so as to allow of partial separation of contiguous vertebræ, or, as in cases 14 and 15, a vertebra may be fractured—but without any displacement of the broken fragments, or other sign by which it is possible during life to determine the exact amount of injury that has been inflicted on the parts external to the cord. In this respect injuries of the spine again closely resemble those of the head—their chief importance depending, not on the amount of injury to the containing, but on that inflicted upon the contained parts. In the spine just as in the head, it will sometimes be found after death from what appears to be, and in reality is, simple injury of the nervous centres, that the vertebral column in the one case, and the skull in the other, have suffered an amount of injury that was unsuspected during life; and which, though it may not in any way have determined the fatality of the result, yet affords conclusive evidence of the violence to which the parts have been subjected, and the intensity of the disorganising shock that they have suffered.

There is, however, this very essential difference between the spine and the head in these respects—that a simple fracture of the cranium may be of no moment except so far as the violence that has occasioned it may have injured the brain. Whilst in the spine the case is not parallel: for as the vertebral column is the centre of support to the body, its action in this respect will be lost when it is broken; even though the spinal cord may not have been injured by the edges of the fractured vertebræ, but only violently and possibly fatally concussed by the same force that broke the spine itself.

Boyer had long since noticed the very interesting practical fact, that when the interspinous ligaments were ruptured in consequence of forcible flexion of the spine forwards, no fatal consequences usually ensue, the integrity of the parts being restored by rest. But that when the ligamenta subflava are torn through, and the arches separated, paraplegia and death ensue. This he attributes to stretching of the spinal cord. Sir C. Bell, however, with great acuteness, has pointed out the error of this explanation, and states that 'it is the progress of inflammation to the spinal marrow, and not the pressure or extension of it, which makes these cases of subluxation and breach of the tube fatal'

(p. 149). There can be no doubt that this explanation is the correct one, and that when once the spinal canal is forcibly torn open, fatal inflammation will spread to the meninges and to the medulla itself.

The secondary consequences of concussion of the spine, more especially when following slight injuries of the spine, will be fully detailed in subsequent lectures. I may, however, describe here perhaps the most marked case on record of inflammatory softening of the cord consequent upon concussion of it, unattended with any injury to the osseous or ligamentous structures of the spine. It occurred in the practice of Dr. Hunter, of Edinburgh, and is related by Abercrombie. It was that of a man thirty-six years of age, who fell from the top of a waggon, a height of ten feet, into a pile of small stones, striking his back between the shoulders. He was immediately rendered paraplegic. When admitted into the Edinburgh Infirmary at the end of a month he was greatly emaciated; there was paralysis of motion, but not of sensation in the lower extremities, retention of urine, involuntary liquid motions, deep-seated pain on pressure in the region of the third, fourth, and fifth dorsal vertebræ. Three days after admission tetanic symptoms came on; then more general spasms of the limbs and body, of which he died in forty-eight hours. On examination after death there was no injury found to the spine itself. There was a high degree of vascularity of the pia mater of the cord in the dorsal region. There was most extensive softening of the body of the cord, affecting chiefly the anterior columns. 'These were most remarkably softened throughout almost the whole course of the cord; in many places entirely diffuent; the posterior columns were also softened in many places, though in a much smaller degree' (p. 348).

This case epitomises so succinctly and clearly the symptoms and after-death appearances occurring in cases of inflammatory softening after uncomplicated concussion of the cord from severe and direct violence, that it needs neither comment nor addition.

The consideration of these subjects in connection with concussion of the spine, as the result of severe and direct violence, will pave the way for what I shall have to say in the next lecture about concussion of the spine as the result of slight, indirect, and less obvious injuries.

LECTURE IV.

ON CONCUSSION OF THE SPINE FROM SLIGHT OR INDIRECT INJURY.

IN the last lecture I directed your attention to the symptoms, effects, and pathological conditions presented by cases of concussion of the spine, proceeding from the infliction of severe injury directly upon the vertebral column so as immediately and injuriously to influence the organisation and action of the delicate nervous structures included within it.

My object in the present lecture is to direct your attention to a class of cases in which the injury inflicted upon the back is either very slight in degree, or in which the blow, if more severe, has fallen upon some other part of the body than the spine, and in which, consequently, its influence upon the cord has been of a less direct and often of a less instantaneous character.

Nothing is more common than that the symptoms of spinal mischief

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in a railway collision, and those from a fall or ordinary accident—except perhaps in severity—and that therefore it is an error to look upon a certain class of symptoms as special to railway accidents. I cannot,

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influence upon the cord has been of a less direct and often of a less instantaneous character.

Nothing is more common than that the symptoms of spinal mischief

do not develop for several days after heavy falls on the back. The following is an illustration of this fact.

Case 17.—E. W., aged 39, consulted me on June 10, 1872, for severe pain in the lumbar spine, and inability to walk and ride. The history he gave was this: that four months previously, on February 28, 1872, he had been thrown in hunting by his horse falling. He turned completely over and landed on his back. He got up and went on as if nothing had happened. It was not till a week afterwards that whilst quietly trotting he was seized with pain in the small of his back. He was obliged to go home and keep his bed for eight days, since which time he had not been able to ride, and had suffered the usual symptoms of spinal concussion.

Cases such as this are extremely interesting to the surgeon, for not only is the relation between the injury sustained and the symptoms developed less obvious than in the former class of cases, but in consequence of the length of time that often intervenes between the occurrence of the accident and the production of the more serious symptoms, it becomes no easy matter to connect the two in the relation of cause and effect.

Symptoms indicative of and arising from concussion of the spine have of late years been very often met with in surgical practice, in consequence of the frequency of injuries sustained by passengers in railway collisions, and they have been very forcibly brought under the observation of surgeons in consequence of their having become fertile sources of litigation; actions for damages for injuries alleged to have been sustained in railway collisions having become of such frequent occurrence in our courts of law as now to constitute a very important part of medico-legal enquiry.

The symptoms arising from these accidents have been very variously interpreted by surgeons, some ignoring them entirely, believing that they exist only in the imagination of the patient, or, if they do admit their existence, they attribute them to other conditions of the nervous system than any that could arise from the alleged accident. And when their connection with, and dependence upon, an injury have been incontestably proved, no little discrepancy of opinion has arisen as to the ultimate results of the case, the permanence of the symptoms, and the curability or not of the patient.

It will be my endeavour in these lectures to clear up these important and very intricate questions; and in doing so I shall direct your attention particularly to the following points:—

1. The effect that may be produced on the spinal cord by slight blows when inflicted on the back or on a distant part of the body.
2. The length of time that may intervene between the alleged injury and the development of the symptoms.
3. The diagnosis of the symptoms of 'concussion of the spine,' from those arising from other morbid states of the nervous system.
4. The grounds on which to form a prognosis as to the probable result.

I shall illustrate these various points by cases selected from my notes, not only of persons who have been injured on railways, but also in the ordinary accidents of civil life.

But before we proceed further, I would wish particularly to direct your attention to the fact that there is in reality no difference whatever between the symptoms arising from a concussion of the spine received in a railway collision, and those from a fall or ordinary accident—except perhaps in severity—and that therefore it is an error to look upon a certain class of symptoms as special to railway accidents. I cannot,

indeed, too strongly impress upon you the fact that there is in reality nothing special in railway injuries, except in the severity of the accident by which they are occasioned. They are peculiar in their severity, not different in their nature from injuries received in the other accidents of civil life. There is no more real difference between that concussion of the spine which results from a railway collision and that which is the consequence of a fall from a horse or a scaffold, than there is between a compound and comminuted fracture of the leg occasioned by the grinding of a railway carriage over the limb and that resulting from the passage of the wheel of a street cab across it. In either case the injury arising from the railway accident will be essentially of the same nature as that which is otherwise occasioned, but it will probably be infinitely more severe and destructive in its effects when it affects the nervous system, owing to the greater violence by which it has been occasioned, and especially because it is not the result of one single shock, as when a rider is thrown from his horse, or a bricklayer falls from a scaffold, but is due to a succession of rapidly repeated concussions. When a person is thrown to and fro in a railway collision, he is dashed forwards and backwards, mixed up, as it were, and entangled amongst his fellow passengers, alike powerless to resist the momentum of the great masses in motion around him or to extricate himself from the destructive jarring vibrations of the splintering carriage.

The consideration of the effects that may be produced on the spinal cord by *slight* blows, whether applied to the back or to a distant part of the body, is not altogether a matter of modern surgical study arising from the prevalence of railway accidents, but had, long antecedent to the introduction of modern means of locomotion, arrested the attention of observant practitioners.

Abercrombie, writing in 1829 says, that chronic inflammations of the cord and its membranes 'may supervene upon very slight injuries of the spine;' and further on he says, 'every injury of the spine should be considered as deserving of minute attention. The more immediate effect of anxiety in such cases is inflammatory action, which may be of an acute or chronic kind; and we have seen that it may advance in a very insidious manner even after injuries that were of so slight a kind that they attracted at the time little or no attention' (p. 381.)

Nothing can be clearer and more positive than this statement. These remarks of Abercrombie are confirmed by Ollivier, by Bell, and by other writers on such injuries.

The following cases will illustrate this point.

The two first are cases of concussion of the spine resulting from railway accidents, in which there were at the time slight marks of external injury. The others are very similar cases occurring from other accidents than those received on railways.

Case 18. Nervous Shock from Railway Collision—Chronic Meningitis of Cord and Base of Brain—Imperfect Recovery after Nine Years.—Mr. R., 35 years of age, a farmer and miller, of very active habits, accustomed to field sports, and much engaged in business, habitually in the enjoyment of good health, was in a railway collision that took place on November 4, 1864. He received a blow on his face which cut his upper lip on the left side, and was much and severely shaken. He did not lose consciousness, and was able shortly to proceed on his journey. On leaving the station to proceed to his own home, it was observed by a friend who drove him that he did not appear to recollect the road, with which he was familiar, having been in the daily habit of driving over it for years.

On reaching home, feeling bruised, shaken, and confused, he took to his

bed, but did not feel sufficiently ill to seek medical advice until November 9, five days after the accident, when he sent to Mr. Yorke, of Staunton, who continued to attend him. But notwithstanding every attention from that gentleman, he progressively but slowly got worse.

I saw Mr. R. for the first time on February 18, 1866, fifteen months after the occurrence of the accident, when I found him in the following state: his face was pallid, much lined, indicative of habitual suffering. He looked much older than his alleged age (36 years). He was sitting with his back to the light, and had the venetian blinds drawn down so as to shade the room, the light being peculiarly distressing to him. His skin was cool. Tongue slightly furred, appetite moderate, digestion impaired. Pulse 104 to 106, weak and compressible. I understood from Mr. Yorke that it rarely fell below this, and often rose above it. He had not lost flesh, but all his friends said that he was quite an altered man.

He stated that since the accident his memory had been bad—that he could not recollect numbers—did not know the ages of his children, for instance—he could not add up an ordinary sum correctly—he would add up the same set of figures if transposed differently. Before the accident he was considered to be a particularly good judge of the weights of beasts—since its occurrence he had lost all power of forming an opinion on this point. He had been quite unable to transact any business since the injury. He was troubled with frightful dreams and often started and waked up in terror, not knowing where he was. Had become irritable, and could neither bear light nor noise. He frowned habitually, so as to exclude the light from his eyes. He complained of stars, sparks, flashes of light, and coloured spectra flaming and flashing before the eyes. He could not read for more than two or three minutes at a time, the letters becoming confused, and the effort being painful to bear. On examining the state of the eyes, I found that vision was good in the right eye, but that this organ was over sensitive to light. Vision was nearly lost in the left eye, so much so that he could not read large print with it.

His hearing was over sensitive with the right ear, dull on the left side. He could not bear noises of any kind, more particularly if sudden; they were peculiarly distressing to him. Even that of his children at play annoyed him.

He complained of a numb sensation accompanied by tingling, burning sensations on the right side, in the right arm and leg, more particularly in the little and ring-fingers, and along the course of the ulnar nerve. The rest of the right hand felt numb. He made no complaint of the left arm or leg. These sensations were worst in the morning.

He could not stand or walk without the support of a stick, or resting his hand on a piece of furniture. He could stand in this way on the left leg, but if he attempted to do so on the right foot the limb immediately bent, and sank as it were under him. His gait was very peculiar. He separated the feet so as to make a straddling movement, and brought one foot very slowly before the other. He advanced the right foot less than the left, and did not raise the sole as far from the ground. The foot seemed to come down too quickly. He did not drag with the toes, but did not raise the heel sufficiently, and was apt to catch it in walking in inequalities on the ground. Flexion and extension were more perfectly and rapidly performed with the left than the right foot.

The attitude of his body in walking was very peculiar; the back was stiff, the head fixed, and he looked straight forward without turning it to the one side or the other.

He had great difficulty in going up or down stairs, and could not do

so without holding on by the balustrade. The difficulty was greatest in going down stairs, and if he attempted this without support he fell or rolled over to the right side.

There was no appreciable difference in the size of the two legs, but the right felt colder than the left. The patient complained of the coldness of both legs and feet.

The spine had lost its natural flexibility, so that the patient kept the body perfectly straight, fixed, and immovable. He could not bend the body in any direction without suffering severe pain. This was complained of equally whether the patient bent forwards, backwards, or sideways. It was most severe on any attempt being made to twist the spine. He sat in a rigid and upright attitude.

There was considerable pain at the occipito-atloid articulation, as well as at that between the axis and atlas. If an attempt was made to bend the head forcibly forwards, or to rotate it, the patient suffered so severely that he had to desist. When directed to look round, the patient turned the whole body.

Owing to the rigidity of his spine he could not stoop to pick anything off the floor without going down on one knee.

On examining the spine by pressure and percussion, three tender spots were found; one in the upper cervical, another in the middle dorsal, and the third in the lumbo-sacral region. There was pain both on superficial and on deep pressure at these spots. The pain was limited to the spine, and did not extend to the muscular structures on either side of it.

The power of retaining the urine was very much diminished. He passed water four or five times in the night, and every second hour during the day. The urine was sub-acid.

The generative power, though impaired, was not lost.

A remarkable circumstance had been noticed in this case by the patient's wife and his friends. It was that since the accident he was unable to judge correctly of the distance of objects in a *lateral* direction, though he appeared to be able to do so when looking straight forward. Thus, when driving in the middle of a straight road he always imagined that the carriage was in danger of running into the ditch or hedge on the *near* side.

The opinion I gave was, that the patient had sustained an injury of the spinal cord, and that the base of the brain was also, to some extent, though probably secondarily, involved. That chronic subacute meningitis of the spine and base of the cranium had taken place. That it was not probable that the patient would ever completely recover, and that it was even doubtful whether, as the disease had up to the present time been progressive, it might not continue so, and terminate in irremediable disorganisation of the nervous centres. The patient was seen by Sir Charles Hastings and Mr. Carden, who took a similarly unfavourable view of his present state and probable future.

An action was brought at the spring assizes at Worcester, in 1866, against the Company on whose line the patient had been injured. No surgical evidence was called for the Company, the statement made by the plaintiff's medical advisers being accepted. Nine years after the accident, in 1873, I had an opportunity of hearing of the patient from his medical attendant. The report I then received was that he had never recovered his bodily health and strength, that his judgment was often at fault, that he committed extravagant and foolish acts, and was not to be relied on in business matters.

Case 19. Injury to Nervous System from Railway Collision—No Immediate Effects—Chronic Meningitis—Imperfect Recovery.—Mr. J., 43

years of age, a wine-merchant, healthy and of active business habits, was in a railway collision August 23, 1864. He was suddenly dashed forwards and then rebounded violently backwards.

When he extricated himself from the ruins of the carriage in which he had been travelling (a third-class one), he believed himself to be unhurt—suffering from no immediate effect of the injury he had sustained. He assisted his fellow-passengers, many of whom were much injured, and was thus actively engaged for two hours.

On his return home the same evening, he was greatly excited and very restless; he felt chilly, and his arms and legs tingled. He could not sleep that night.

On the following day he felt ill and shaken; could not attend to his business, and was lame from some slight contusions on his legs. He continued much in this state for several days, and was seen by Mr. Everett, of Worcester (to whom I am indebted for the early history of this case), September 1, eight or nine days after the accident. He was then much disturbed in health; his pulse was feeble, he looked anxious and depressed; he complained of violent pains in the head, confusion of thought, and loud noises in the ears and head. He also complained, but slightly, of pain in the back.

These symptoms continued for some time without improvement. He found more and more difficulty in walking, and his right ankle often gave way. This appeared to Mr. Everett to be owing to some spasmodic action of the muscles of the leg rather than to any weakness of the joint itself.

He now began to show more serious symptoms in connection with the nervous system. His memory became worse and his confusion of ideas greater; he often called people and things by wrong names; addressed his wife as 'Sir.'

The pains in the head became more violent, and assumed a paroxysmal character. There was acute sensibility to sound in the right ear, deafness of the left. The vision of the right eye was rather dim.

This was his condition twelve weeks after the occurrence of the accident. The symptoms, though progressively assuming a more and more serious character, did not do so uninterruptedly, but as Mr. Everett expresses it, were 'undulatory'—sometimes better, sometimes worse; but yet at the expiration of any given time of a few weeks' duration, decidedly and persistently worse than at an earlier period.

Three months after the accident he began to complain, for the first time, of contractions of the muscles of the right arm and hand. His fingers became flexed, so that force was required to straighten them. Shortly afterwards the left arm became similarly affected. These contractions assumed an intermittent and spasmodic character, and occurred several times daily.

The pain in the back, which was but slightly complained of at first, now became more and more severe. It was more acute from the sixth to the tenth dorsal vertebræ. Spasms of the diaphragm now came on occasionally, and distressed him much.

His gait was peculiar; he seemed to be uncertain where to set his feet, and he kept his head steadily fixed.

February 1, 1865, five months after the accident, he complained, for the first time, of pain in the neck, greatly increased on moving the head.

During the whole of this period his digestion had been fairly good. He had gained flesh since the accident. There had been no loss of power over the sphincters, and his urine was normal and acid.

I saw this patient, in consultation with Mr. Carden and Mr. Everett,

of Worcester, on March 8, 1865, and found that the symptoms above detailed continued and had somewhat increased in intensity since the last report.

He suffered from loss of memory, confusion of thought and ideas, utter incapacity for business, disturbed sleep, pains and noises in the head, partial deafness of the left ear, morbid sensibility of right, irritability of the eyes, rendering light very painful—though vision had become imperfect in the right eye. Numbness, tingling sensation, and formication in the right arm and leg, were the most prominent *subjective* symptoms.

He walked with a peculiar unsteady straddling gait; was obliged to feel with his right foot before planting it on the ground; did not raise the heel, but carried the foot flat, and let it fall suddenly, instead of putting it on the ground in the usual way; used a stick, or supported himself by the furniture.

He could stand for a moment on the left leg, but immediately fell over if he attempted to do so on the right.

His right arm and hand were numb; the little and ring fingers contracted. He could not pick up a small object, as a pin, between his finger and thumb, nor could he write easily or legibly.

The spine was very tender at three points—in the upper cervical, in the middle dorsal, and in the lower lumbar regions. There was constant fixed aching pain in the spine in these situations. This pain was greatly increased on pressure; it was limited to the vertebral column, and did not extend beyond it.

Movement of any kind greatly increased the pain. If the head was raised by the hands and bent forward, or rotated, so as to influence the occipito-atloid and the atlo-axoid articulations, the patient shrieked with agony.

He could not bend the body either forwards, backwards, or sideways, the pain being so greatly increased in the dorsal and lumbar regions by these movements. Consequently he could not stoop.

The spine had entirely lost its normal flexibility. It was perfectly rigid, moved as a whole as if made of one bone. The patient could neither bend nor turn his head. Hence he could not look on the ground in walking to see where to place his feet; and when he wished to look round, he had to turn the whole body.

The pulse was feeble, about 98. Countenance pale, anxious, haggard. Tongue slightly coated. Digestive and other functions well performed. Urine clear and acid.

The case was tried at the Spring Assizes at Worcester in 1865. The opinion expressed by Mr. Carden, Mr. Everett, and myself amounted to this, that the patient was suffering from concussion of the spine, which had developed irritation or chronic inflammation of the cord and of its membranes, and that his recovery was very doubtful.

In May 1866, a year and nine months after the accident, he was still an invalid, being so completely shattered in health that he has been obliged to winter in the south-west of England, and was quite unequal to attend to business of any kind.

In 1871, seven years after the accident, Mr. Walsh, of Worcester, informed me that Mr. J. was still an invalid, that he was obliged to walk with two sticks, and had not recovered the sense of taste; and two years later than this, viz., in 1873, Dr. Weir, of East Malvern, informed me that Mr. J.'s condition continued unimproved.

Case 20. Carriage Accident—Slow supervention of Symptoms of Chronic Cerebro-Spinal Meningitis—Incurable.—The following case illustrates the fact that a train of symptoms of a most persistent nature, closely

resembling those detailed in the preceding cases, may occur from other causes than railway accidents.

Captain N., aged 38, consulted me on October 27, 1862. He looked careworn, pale, lined, and at least ten years older than his real age. He stated that in November 1854—eight years previously—he had been thrown out of a pony-chaise, which was accidentally upset. He hurt his right knee and bruised the right arm, but sustained no blow, and there was no evidence of injury on the head or back. He was much bruised and shaken at the time, but did not suffer any serious ill effects for several months after the accident, although during the whole of this period he felt ailing, and was in some way suffering from the injury he had sustained.

About six months after the accident he began to be troubled with the following train of symptoms, which had continued ever since:—Confusion of thought; impairment of memory; giddiness, especially on moving the head suddenly; failing sight; *muscæ volitantes*, and sparks and flashes of light. He could not continue to read beyond a few minutes, partly because the letters ran into each other, partly because he could not concentrate his thoughts so as to fix his attention.

He now began to suffer from a feeling of numbness and a sensation of 'pins and needles' in both hands, but more particularly in the left, and chiefly in those parts supplied by the ulnar nerve.

He complained of similar sensations in the left leg and foot. He walked with difficulty, and with the legs somewhat apart, using a stick, or else supporting himself by holding on to pieces of furniture in the room as he passed them. He could stand on the right leg, but the left one immediately gave way under him. He walked with great difficulty up and down stairs, and was obliged to put both feet on the same step. The spine was tender on pressure and percussion in the lower cervical region and between the shoulders. The spine was stiff and he could not bend the back without pain, and could not stoop without falling forward.

He had irritability of the bladder, passing water every second or third hour, and could only do so in a sitting posture. He had completely lost all sexual power and desire. The urine was slightly acid. These symptoms had continued with varying intensity since about six months after the accident. He thought they were most severe about a year after they began, and had somewhat improved since then. But he had never been free from them, or enjoyed a day's health, for the last seven and a half years, and did not expect to do so.

This case closely resembled, in all its general features, and in many of its details, those that have just been related. It only differed in the symptoms being less intense, as would naturally be expected, from the accident that occasioned them being less severe than those which occur from railway collisions. The persistence of the symptoms for so lengthened a period as nearly eight years was significant of the tenacity and long duration of the pernicious effects of these insidious and at first apparently slight injuries to the nervous system.

But the prolonged duration of the most serious nervous phenomena, from comparatively slight injuries to the spine, receives additional illustration from the following case.

Case 21. Injury of Spine in Infancy—Persistence of Symptoms to Adult Age.—Miss B., aged 26, was brought to my house, April 11, 1866, by Sir Duncan Gibb. She looked moderately healthy, was of good constitution, with no discernible hereditary tendency to disease of any kind and was not anæmic. The digestive and uterine functions were well performed. She had had no disease except that from which she was then suffering, no convulsions or fits in childhood.

When about eighteen months old, she fell out of her cot and injured her cervical spine. From that time she had suffered from a continuous and remarkable train of nervous phenomena which were aggravated about the period of puberty, and which were still further increased at the age of 17, in consequence of her falling over a stile backwards. She had never had hysteria in any of its ordinary forms, or paralysis, epilepsy, or convulsive attacks of any kind.

On examining the spine, I found no lateral curvature and the body was well formed. There was a distinct projection backwards of the spinous processes of the fifth and sixth cervical vertebræ. She complained of a constant pressure and pain of a grating or grinding character in this region, as if the bones were in contact with one another. There was no evidence of abscess or of any distinct mischief in or around the tender vertebræ, and nothing was to be observed with the laryngoscope at the anterior part of the cervical vertebræ or in the pharynx. From the projection of the cervical vertebræ a peculiar sense of uneasiness spread itself over the whole of the body and limbs, producing nervous sensations of the most distressing character. These sensations, which consisted of tingling and painful feelings, prevented her sitting still or lying down quietly for any length of time. She was better when in movement. She could not sleep for more than an hour or two at a time, and was conscious of her sufferings through her sleep.

Her power of movement had never been impaired, the distress being confined to sensation, and not producing any disturbance of motion.

She could walk well under certain circumstances, could stand, and in fact she scarcely ever sat; but she could not turn suddenly without becoming giddy and afraid of falling.

She could walk well so long as there was anything near her. Thus she could walk along a street guided by the area railings; but when she came to an open space, as a square or crossing, she was lost, and required to be guided or she would fall. She could not bear the sensation of having a space around her, and would fall unless supported.

She had unceasing loud noises in her head, which she compared to 'gravel stones' rolling through it. They were so loud that she fancied that other people must hear them.

Her hearing was good.

Her sight was strong, but she saw the circulation of the blood in her eyes, the corpuscles spinning round in convolutions, and often coloured. There was no perversion of smell or taste. The hands and feet were always cold, even in summer.

She had been from first to last under the care of at least thirty medical men, and had had every variety of treatment applied—even a seton kept open in the neck and the clitoris excised; but so far from benefiting she had slowly but steadily become worse, and her general health was, when I saw her, now beginning to give way.

This lady, who was remarkably intelligent, gave a lengthened and minute history of her ailments, of which the above is a sketch. She referred all her morbid sensations to the seat of the excursion in the cervical vertebræ. At this point there had evidently existed disease leading to organic changes to which the remarkable train of general phenomena were doubtless referrible. If I were to hazard an opinion, it would be that some thickening of the meninges of the cord had probably taken place, the effect of which was to interfere with the sensory portion of the cord, rather than with the motor.

Since the period referred to above this patient has married and has had children, but her condition of health, so far as the nervous system is concerned, continues unchanged.

LECTURE V.

CONCUSSION OF THE SPINE FROM GENERAL SHOCK.

THERE is another class of cases of an extremely insidious and protracted character to which I wish to direct your attention, viz., those cases in which the patient has received no blow or injury upon the head or spine, but in which the whole system has received a severe shake or shock, in consequence of which an immediate lesion, probably of a molecular character, is sustained by the spinal cord, and disease of an inflammatory character, or of a disorganising nature dependent on modification of nutrition, is developed in it, the inflammatory action eventually creeping up to the membranes of the brain. These cases, although necessarily more frequent in railway than in other injuries, do occasionally occur as a consequence of ordinary accidents. I will first relate a case of this kind, and then direct your attention to the details of several other instances that have fallen under my notice of similar phenomena occurring after railway accidents.

Case 22. Concussion of Spine in Hunting—No Direct Injury of Back—Immediate and Severe Symptoms of Meningeal Extravasation—Phlebitis—Pleuro-Pneumonia—Complete Recovery.—A gentleman about 60 years of age, healthy, of active habits, and much given to field sports, whilst jumping a drop-fence on March 2, 1872, landed on the pommel of the saddle. He was not thrown, but felt himself violently jarred. His first impression was that he had smashed the testes, and that blood was running down his thighs. He placed his hand instinctively to the part, but finding no bleeding concluded that an internal laceration had taken place. He gradually fainted away on his horse; was taken off and carried home in a cart, a distance of about four miles. He was found to be completely paralysed as to motion in the lower extremities, and there was not the slightest power below the pelvis. When the limbs were moved he suffered intense agony in the middle of the back. There was a disposition on the part of the right lower extremity to become abducted, to 'stray' away, and he suffered great pain when it was replaced in the straight position. He had control over the bladder, but not over the sphincter ani; there was no priapism.

He was placed on a water-bed, treated by dry cupping to the spine, and had small doses of the perchloride of mercury in bark. I saw him on April 9, five weeks after the accident, in consultation with Mr. Francis. I found that there was some improvement in his condition; that the pains in the limbs were less severe, and that the power over the sphincter ani had been in some measure regained, though flatus still at times escaped involuntarily. The left leg and foot were weaker than the right, and felt very cold and even numb. When out of bed he could scarcely move, and only with great difficulty; his legs became deeply cyanosed; he felt faint and was obliged to lie down again. When recumbent he could move the legs somewhat. His general health was good; head free; spirits and courage excellent. He gradually improved up to May 4, when he got a severe pleuritic stitch in the right side, for which he was blistered with advantage. On May 21, a severe attack of obstructive phlebitis developed itself on the right leg, the saphenous vein becoming blocked, and the common femoral implicated,

with great œdema of the limb. This was appropriately treated, and he made a good recovery from it.

June 2 he dined downstairs, and on the ninth was able to walk to his stables, and rapidly improved in his power of locomotion. On the 29th he was seized with a severe stitch in the right side. This gradually increased until July 7, when Mr. Marriott, of Leicester, who had been called in, found effusion up to a height of four inches, attended by the most excruciating pain. The following day the left pleura became implicated.

On July 9 I saw him in consultation with Mr. Marriott, and found him in a most precarious state. Extensive pleuritic effusion on both sides; double pneumonia; dusky countenance; deep rusty-coloured sputa; pulse 120; temperature 101.2° ; respiration 44. He was ordered five grains of carbonate of ammonia, and chloric ether every four hours; two drachms of brandy every alternate four hours, and one grain of calomel with one-sixth of a grain of morphia at night. Under this treatment he gradually improved, so that on the 14th Mr. Marriott wrote that the pleuritic effusion was subsiding; lungs clearing up; respiration tranquil, 18 to 20; pulse 100; temperature 99° ; sputa scarcely tinged with blood. From this time his improvement was progressive. It ought to be observed that previous to his attacks of phlebitis and pleurisy he had been very sick for several days.

In September he went to Brighton in a state of much debility. He could only walk with difficulty, and with the aid of crutches or two sticks. Scarcely able to crawl, he stayed there a month; took Turkish baths with much advantage, leaving greatly improved in motor power and general health. From this time his recovery was progressive, and the recovery so far as the paraplegia and spinal symptoms were concerned was complete, the patient being able to walk and ride without any sign of weakness. After much exercise he felt, however, a dull aching pain in the lumbar spine.

This case is an excellent illustration of the supervention of phlebitis and pleuro-pneumonic inflammations after injury of the spine, and paraplegia, probably dependent on meningeal extravasation.

There was this clinical sequence:—1. Severe concussion of spine from below upwards. 2. Immediate paraplegia with external ecchymosis. 3. Thrombosis of saphena and femoral veins. 4. Acute (embolic) pleuro-pneumonia. 5. Eventual recovery.

Case 23. Fall in Hunting—No Direct Blow on Head or Back—Slow Development of Symptoms.—H. B., aged 30, groom in a hunting-stable, was sent to me March 8, 1872. Always active and healthy. He stated that on Dec. 26, 1871, was thrown on soft ground whilst going fast; had no blow on head or back, but was struck on the chest by the horse in getting up. He thought nothing of it, and went on; felt no bad effect for two or three days; then had 'faltering' in the legs, which felt numb and cold; he could not walk or stand for any length of time without support, and had been obliged to use a stick ever since. On the fifth day (Dec. 31) he began to suffer in his head. Since then till the time I saw him he had had the following symptoms: viz., a constant 'whirl' in his head; giddiness; confusion of thought and forgetfulness of ordinary occurrences; slight deafness in both ears, but especially in the right; feeling of numbness in both legs; the sphincters acted normally, and there was no pain in the head or spine; he walked with a tottering unsteady gait, and with the aid of a stick; he moved the feet with difficulty, and there was slight impairment of sensation as well as of motion; sight good; pulse 72; bowels regular. He had been well leeches, blistered, and purged before I saw him; but without

much, if any benefit. I put him on a course of the perchloride of mercury and quinine.

March 22.—He had considerably improved in all the nervous symptoms, but felt very weak. I ordered the perchloride of iron instead of that of mercury.

April 30.—Felt stronger and better, but his head swam if he hurried himself; he could walk better, but was not quite safe without the stick; he was still unable to ride, as he found his head became confused, and he complained of a loud noise like that of an engine in it; he had become very deaf, so that it was necessary to call loudly to him. This interfered much with his comfort and safety. Could not sleep well; pulse 76, soft. Ordered in addition to the iron, the bromide of potassium, which he took with much benefit.

Case 24. *Fall in Hunting—Slow Development of Symptoms after Slight Blow on Head.*—W. A., aged 42, consulted me on Feb. 6, 1872, by the advice of Dr. Cowan, of Glasgow. He had been a man of active habits, addicted to field sports. Stated that twelve years ago he had a heavy fall in hunting, the consequences of which he felt in the way of giddiness, confusion of thought, and general ill health for about a year. At the expiration of that time he recovered, and was able to resume his usual occupations at the desk and in the field. In March, 1870, nearly two years before I saw him, he had another fall, striking the head on the left side, but not materially bruising or otherwise injuring it externally. He was not stunned; he rode the whole day, went to a dinner party afterwards, next day he went to business, and to a ball in the evening, feeling no ill effects of his accident. On the fourth day he woke giddy, had double vision, pain across the forehead, confusion of thought, inability to concentrate his thoughts, &c., and was obliged to give up all occupation for two months. He then returned to business, but found that he could not concentrate his thoughts or devote himself so closely to it as before the accident. The double vision also continued for nearly a twelvemonth, when he thought he had fairly recovered. On resuming his former life he felt that he was not equal to it. He now began to suffer from extreme nervous depression; a sense of exhaustion after slight mental exertion or bodily efforts. His appetite failed him; latterly he had been able to eat little solid food. Had become emaciated, and lost more than a stone in weight. His pulse was feeble, and about 90. His sight was not good, but the pupils were remarkably contracted—looked like pin-hole apertures in the iris. He passed much pale urine of light specific gravity, but otherwise normal. The treatment on which he was put consisted of cod-liver oil, nuxvomica, &c., with carefully regulated diet and rest.

This case is an instance of the slow development, after an interval of apparent health, of a long-continued train of cerebral symptoms from a slight but direct blow on the head.

Case 25. *Carriage Accident—No Direct Injury of Head or Spine—Slow Development of Symptoms—Palsy and Anæsthesia in one Side—Hyperæsthesia in other—Gradual Recovery.*—A gentleman, aged 44, was injured on Jan. 16, 1874, on his way to an evening party, by the brougham in which he was driving being upset by a tram car. He was not bruised, stunned or visibly injured. He went to the party where, though feeling nervous and shaken, he danced till 3 a.m. He returned home, and though not feeling well, went to business the next day, the 17th. In the afternoon of that day, about eighteen or twenty hours after the accident, he felt uneasy sensations in the right hand. This became gradually palsied and anæsthetic. On the 19th, the third day after the accident, he was seized with severe pain in the lower cervical

and upper dorsal spines, and the left upper extremity became suddenly hyperæsthetic. It was especially sensitive to the cold, and the application of cold water or the impact of a cold current of air caused him to feel, as he said, 'scalded by ice.'

On the 20th he lost power in the right leg, and the palsy gradually crept on, involving the left lower extremity; the sphincters were, however, not affected. He was attended by Mr. Llewellyn, Dr. Moxon, and Mr. Jabez Hogg, and was treated with large doses of iodide of potassium. When I saw him on Jan. 20, 1875, a year after the accident, he had in a great measure recovered. The right arm, hand, leg, and foot were, however, still partially paralysed, with some contraction about the muscles of the shoulder and leg, so as to impair the use of the limbs. He could not write as before, could not walk up and down stairs except step by step, could not dress or undress without assistance. His business aptitude was greatly reduced.

This case is remarkably interesting in several respects: 1. That the paralysis and spinal symptoms did not begin to show themselves for nearly 24 hours after the accident. 2. That there had been no blow or direct injury to the spine. 3. That the symptoms were clearly explicable by Brown-Séguard's experiments on semi-section of the cord; and, lastly, the contraction of some of the muscles and the absence of palsy of the sphincters, indicated that the lesion was probably meningeal, in great part at least.

Case 26. Concussion of Spine by Fall on Feet—Gradual Supervention of Paralysis—Death.—On Nov. 17, 1861, I saw, in consultation with Dr. Strong, of Croydon, Mrs. B., aged 32. She stated that in November, 1860, whilst going down-stairs, she accidentally stepped upon the side of a pail, and slipped forwards, bumping down three or four stairs forcibly on her heels. She did not lose her footing, did not fall, and did not strike any part of the body or head. Of this she was quite certain. She felt nervous, faint, and shaken at the time, and was obliged to take some brandy. At the period of the occurrence of the accident, and up to that time, she had been a strong, healthy, and active woman. She was married, and the mother of two children. She had never suffered from any disease of the nervous system, or from any serious complaint.

Two days after the trifling accident that has just been described, she was attacked with neuralgic pains in the right side of the head—apparently hemicrania. For this she was treated in the usual way, and did not feel it necessary to lay up. About a fortnight after the accident, she felt numbness and tingling conjoined in the right arm, hand, and leg, and also on the right side of the head, where the neuralgia had previously existed. The numbness after a time extended to the right half of the tongue.

When I saw her three months after the accident the numbness and tingling existed unchanged in these parts, and the left hand and arm had also begun to be affected. She felt a numb sensation in the little and ring fingers, and slightly in the middle finger.

Although there was this numb sensation in the hands, and in the right leg, she had no impairment of motion. She could pick up a pin, untie a knot, and otherwise use the right hand, which was the one most affected, in ordinary small occupations. She could stand and walk fairly well.

I saw the patient again on April 13, four months after the accident. Notwithstanding the treatment that had been adopted (iron and strychnine), she was weaker, looked anæmic, and was rather worse, so far as the paralytic symptoms were concerned. She could no longer pick

up so small an object as a pin, but could pick up a piece of money—a shilling for instance. The right hand and leg were still the worst, but the left limbs were more affected than previously. In the left hand the numbness had now affected the little, ring, and middle fingers, with the tip of the forefinger.

From this time there was a very slow increase in the symptoms, notwithstanding a great variety of treatment to which the patient had been subjected by the many different medical men whom she had seen. On examining her, on April 10, 1866, about five and a half years after the accident, with Mr. Ayling, her present medical attendant, she told me that she felt that she was progressively, though very slowly, getting worse. She had an anxious anæmic look. She tottered in walking, so that in going about the room she supported herself by the chairs and tables. She could not in any way walk a quarter of a mile. She could stand unsupported on the left leg, but she immediately fell over if she attempted to do so on the right. The right hand and foot were much colder than the left. The paralysis of the hands continued much the same, but a marked change had taken place in the right hand in consequence of the contraction of all the fingers, but more especially of the little and ring fingers. They had become rigid, and the flexor tendons stood out strongly. She could, consequently, scarcely use this hand. On testing the irritability of the muscles in the opposite limbs by galvanism, the contraction was almost *nil* in those of the right arm and hand. Much stronger, though not normally strong, on the left side.

She complained of confusion of thought and loss of memory; the senses were unimpaired. Appetite was bad, and digestion imperfect. Urine was acid. She could hold her water well.

March, 1868.—Since the last report her symptoms had slowly and gradually become aggravated. She was now almost helpless. There was partial paralysis of sensation and of motion in both lower extremities, but much more marked in the right than in the left; so that she could not at all support herself without a stick or holding on to furniture. The right hand and arm were almost numb, the fingers drawn up and clenched. She could not dress herself. She was much depressed in spirits, and enfeebled in mind.

From this time she slowly became worse, gradually becoming more and more extensively paralysed, and at length died in August, 1871, from the remote effects of this accident.

In this case a very trifling accident occasioned a jar which was communicated to the feet, and evidently transmitted to the nervous centres, leading to impairment of innervation, and eventually to progressive and incurable paralysis.

Case 27. General Shock—Symptom of Concussion of Cord—Slow Recovery.—H. M. L., a surgeon, aged 43, naturally a stout healthy man, of active professional habits, consulted me on February 22, 1865. He stated that on October 9, 1864, he was in a railway collision, by which he was thrown forwards, but without any very great violence. He received no blow on the back, head, or other part of the body. He was much frightened and shaken, but did not lose consciousness.

Beyond a general sensation of illness, he did not suffer much for the first three or four weeks after the accident, but he was not able to attend to his business; could not collect his thoughts sufficiently for the purpose.

About a month after the accident he began to suffer from pain across the loins. He could not walk without great fatigue. He lost strength and flesh, and his pulse became habitually much more frequent than natural, being about 98 to 100.

When I saw him four and a half months after the accident, he continued much in the same state; was quite unfit for business, and had been obliged to relinquish practice; not owing to any mental incapacity, but entirely owing to his bodily infirmities. His mind was quite clear, and his senses perfect, though over-sensitive; loud and sudden noises and bright light being particularly distressing to him.

He complained chiefly of the spine. He suffered constant pain in the lower part of it, in the lower dorsal, and the lumbar regions. He compared the sensation there experienced to that of a wedge or plug of wood driven into the spinal canal. It was a mixed sensation of pain and distension. The spine generally was tender, and the pain in it was greatly increased by manipulation, pressure, and percussion. It had lost its normal flexibility, moved as a whole, so that he could not bend forwards or stoop. There was no pain in the cervical region, or on moving the head.

He complained of painful numbness and formications in the right, and occasionally down the left leg. The legs were stiff and weak, especially the right one. He could not stand unsupported on this for a moment. He walked in a slow and awkward manner, straddled, and was not able to place the feet together. If told to stand on his toes, he immediately fell forwards. He had lost control over the limbs, and did not know exactly where to place the feet. He had a frequent desire to pass water, suffered greatly from flatus, and had completely lost all sexual desire and power. The pulse was at 98; appetite bad; digestion impaired.

I saw this patient again, at Brighton, towards the end of April, seven months after the accident, in consultation with Mr. Curtis, and found that his condition had in no way improved. I saw him again in 1878 with Mr. Bellamy. He had tried to follow his profession, but was unable to do so. He had partial paralysis of the musculo-spiral nerve of the right arm with atrophy of the muscles supplied by it. He had partial paraplegia. I believe this mischief to have been of a chronic inflammatory nature; the tenderness of the spine, the feeling of distension, the pain on movement, and the habitually high pulse, pointed in this direction.

Case 28. General Shock—Symptoms of Spinal Concussion and Meningitis—Very Slow and Imperfect Recovery.—Mr. C. W. E., aged about 50, naturally a stout, very healthy man, weighing nearly seventeen stone, a widower, of very active habits, mentally and bodily, was in a railway collision on February 3, 1865. He was violently shaken to and fro, but received no bruise or any sign whatever of external injury. He was necessarily much alarmed at the time, but was able to proceed on his journey to London, a distance of seventy or eighty miles. On his arrival in town he felt shaken and confused, but went about some business, and did not lay up until a day or two afterwards. He was then obliged to seek medical advice, and felt himself unable to attend to his business. He slowly got worse, and more out of health. Was obliged to have change of air and scene, and gradually, but not uninterruptedly, continued to get worse, until I saw him on March 26, 1866, nearly fourteen months after the accident. During this long period he had been under the care of various medical men in different parts of the country, and had been most attentively and assiduously treated by Dr. Elkington, of Birmingham, and by several others, as Dr. Bell Fletcher, Dr. Gilchrist, Mr. Gamgee, Mr. Martin, &c. He had been most anxious to resume his business, which was of an important official character, and had made many attempts to do so, but invariably found himself quite unfit for it, and was most reluctantly compelled to relinquish it.

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DISEASES

OF THE

SPINAL CORD.

BY

BYROM BROMWELL, M.D., F.B.C.P., Edin.,

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School of Medicine, Edinburgh.

NEW YORK:

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ious to resume his business, which was of an important official character,
and had made many attempts to do so, but invariably found himself
quite unfit for it, and was most reluctantly compelled to relinquish it.

When I saw him at this time he was in the following state :—

He had lost about twenty pounds in weight, was weak, unable to walk a quarter of a mile, or to attend to any business. His friends and family stated that he was, in all respects, 'an altered man.' His digestion was impaired, and his pulse was never below 96.

He complained of loss of memory, so that he was often obliged to break off in the midst of a sentence, not being able to complete it, or to recollect what he had commenced saying. His thoughts were confused, and he could not concentrate his attention beyond a few minutes upon any one subject. If he attempted to read, he was obliged to lay aside the paper or book in a few minutes, as the letters became blurred and confused. If he tried to write, he often mis-spelt the commonest words; but he had no difficulty about figures. He was troubled with horrible dreams, and waked up frightened and confused.

His head was habitually hot, and often flushed. He complained of a dull confused sensation within it, and of loud noises which were constant.

The hearing of the right ear was very dull. He could not hear the tick of an ordinary watch at a distance of six inches from it. The hearing of the left ear was normal; he could hear the tick at a distance of about twenty inches. Noises, especially of a loud, sudden, or clattering character, distressed him greatly. He could not bear the noise of his own children at play.

The vision of the left eye had been weak from childhood. That of the right, which had always been good, had become seriously impaired since the accident. He suffered from *muscæ volitantes*, and saw a fixed line or bar, vertical in direction, across the field of vision. He complained also of flashes, stars, and coloured rings.

Light, even of ordinary day, was especially distressing to him. In fact, the eye was so irritable that he had an abhorrence of light. He habitually sat in a darkened room, and could not bear to look at artificial light—as of gas, candles, or fire. This intolerance of light gave a peculiarly frowning expression to his countenance. He knitted and depressed his brows in order to shade his eyes.

The senses of smell and taste seemed to be somewhat perverted. He often thought that he smelled fetid odours which were not appreciable to others, and he had lost his sense of taste to a great degree. He complained of a degree of numbness, and of 'pins and needles' in the left arm and leg, also of pains in the left leg, and a feeling of tightness or constriction. All these symptoms were worst on first rising in the morning.

He walked with great difficulty, and seldom without the aid of a stick; whilst going about a room he supported himself by taking hold of the articles of furniture that came in his way. He did not bring his feet together—straddled in his gait—drew the left leg slowly behind the right—moved it stiffly and kept the foot flat in walking, so that the heel caught the ground and the limb appeared to drag. He had much difficulty in going up and down stairs, could not do so without support.

He could stand on the right leg, but if he attempted to do so on the left it immediately bent and gave way under him, so that he fell.

The spine was tender on pressure and on percussion at these points—viz., at lower cervical, in middle dorsal, and in lumbar regions. The pain in these situations was increased on moving the body in any direction, but especially in the antero-posterior. There was a degree of unnatural rigidity, of want of flexibility, about the spine, so that he could not bend the body—he could not stoop without falling forwards.

On testing the irritability of the muscles by galvanism, it was found to be very markedly less in the left than in the right leg.

The genito-urinary organs were not affected. The urine was acid, and the bladder neither atonic nor unduly irritable.

The opinion that I gave in this case was to the effect that the patient had suffered from concussion of the spine—that secondary inflammatory action of a chronic character had been set up in the meninges of the cord—that there was partial paralysis of the left leg, probably dependent on structural disease of the cord itself—and that the presence of cerebral symptoms indicated the existence of an irritability of the brain and its membranes.

I saw the patient again on April 18, 1867, two and a half years after the accident. He then suffered much from pain in the head, and in the cervical spine. He was subject to fits of continual depression, was generally nervous and little fitted for his ordinary business, memory was defective, and ideas unconnected. The head felt hot, face had a somewhat heavy expressionless look, pulse 96 to 98, digestion bad, urine phosphatic, left leg numb, with occasional darts of pain and sensation of ‘pins and needles.’ It was colder than right leg.

Case 29. General Shock—Concussion of Spine—Chronic Meningitis—Severe Symptoms—Slow and Incomplete Recovery.—The following case presents some very remarkable and unusual nervous phenomena, resulting from railway shock, which I will briefly relate to you.

March 1, 1865.—Mr. D. a man of healthy constitution and active habits, aged 33, was travelling in an “express” (third class, with divided compartment), and was seated with his back to the engine. When near Doncaster, the train going at about thirty miles an hour, ran into an engine standing on the line. He was thrown violently against the opposite side of the carriage, and then fell on the floor.

Immediate Effects.—There was a swelling the size of an egg over the sacrum, severe pain in the lower part of the spine, which, on arriving at Edinburgh the same day, had extended up the whole back and into the head, producing giddiness and dimness of sight. These, with tingling feelings in the limbs (particularly the left), great pain in the back, and tenderness to the touch, sickness in the mornings, and lameness, continued for the first fortnight.

‘The treatment adopted consisted of blisters and hot fomentations to the spine.

‘The patient seemed to improve, and the pain between the shoulders to lessen after these applications.

‘*28th.*—He was seen by an eminent surgeon, who ordered him to go about as much as possible, but to avoid cold. The result of this advice was that he found the whole of the symptoms much increased, with prostration and lameness.

‘*April 20th.*—Left for London, breaking journey for a week in Lancashire, greatly fatigued by journey. A discharge came on from the urethra, the lameness was much increased, he could not advance the left leg in front of the right, and there was great prostration.’

I saw him, in consultation with Mr. Hewer, May 1, 1865, when I received the above account from the patient. He was then suffering from many of the ‘subjective’ phenomena which are common to persons who have incurred a serious shock to the system. But in addition to these, he presented the following somewhat peculiar and exceptional symptoms:—

1. An extreme difficulty in articulation, of the nature of a stammer or stutter of the most intense kind, so that it was extremely difficult to hold a continuous conversation with him. Although he had previously to the accident some impediment in his speech, this had been aggravated to the degree just mentioned, so as to constitute the most marked
 that I have ever heard in an adult.

2. A very peculiar condition of the spine and the muscles of the back. The spine was rigid—had lost its natural flexibility to antero-posterior as well as to lateral movement.

There was an extreme degree of sensibility of the skin of the back, from the nape of the neck down to the loins. This sensibility extended for about four inches on either side of the spine. It was most intense between the shoulders.

This sensibility was both superficial and deep. The superficial or cutaneous sensibility was so marked, that on touching the skin lightly or on drawing the finger down it, the patient started forwards as if he had been touched with a red-hot iron. There was also deep pain on pressure along the whole length of the spine, and on twisting or bending it in any direction.

Whenever the back was touched at these sensitive parts, the muscles were thrown into violent contraction so as to become rigid, and to be raised in strong relief, their outlines becoming clearly defined.

3. The patient's gait was most peculiar. He did not carry one leg before the other alternately in the ordinary manner of walking, but shuffled sideways, carrying the right leg in advance, and bringing up the left one after it by a series of short steps. He could alternate the action of the legs, but he could not bring one leg in front of the other without twisting the whole body and turning, as on a pivot, on the leg that supported him. He could not bend the thigh on the abdomen.

I saw this patient several times during the summer and autumn. In the early part of December, his condition was as nearly as possible the same as that which has been described in May, no change whatever in pain or in gait having taken place. There was not at this time, nor had there ever been, any signs of paralysis, but he complained of the sensation of a tight cord round the waist.

In addition to Mr. Hewer and myself, this patient was seen at different times by Sir W. Fergusson, Drs. Reynolds and Walshe. We all agreed that the patient was suffering from 'concussion of the spine,' and that his ultimate recovery was uncertain.

After the trial he was continuously under my care, and I saw him at intervals of about a month. He was treated by perfect rest, lying on a prone couch; by warm salt-water douches to the spine, for which purpose he resided at Brighton, and by full doses of the bromide of potassium. Under this treatment he considerably improved (May, 1866). The extreme sensibility of the back was materially lessened, and he could walk much better than he did. He also stammered less vehemently, but he still had considerable rigidity about the spine, could only walk with the aid of a stick, and retained that peculiar careworn, anxious, and aged look that is so very characteristic of those who have suffered from these injuries.

March 5, 1870, five years after the accident, this patient called on me. He looked pale, haggard, more than his real age. Had done no business since the trial. Still felt nervous, when put to anything however trivial. Still felt a want of power in left leg and hand, as if asleep or dead. Still had tenderness in lower dorsal and lumbar regions. His health was very variable, often he was unfit for any work.

Case 30. Railway Concussion—Slow Development of Symptoms—Partial Paralysis—Incomplete Recovery.—E. C., aged 47, a gentleman farmer, hale, hearty, athletic, and of active habits, received an injury in a railway collision on July 1, 1865; the carriage in which he was being upset, and he and his fellow passengers thrown violently about. At the time he did not feel himself hurt, was able to creep out of the window and assist the other passengers, and then went on to Lowestoft, his des-

tion. At night, however, he could not sleep, and this was the first symptom that attracted his attention. The next morning he felt stiff, and complained of creeping sensations up and down the back, and of unpleasant sensations, almost amounting to pain, in the head. By the middle of the day he was forced to recline on a couch, as he could scarcely sit up. He felt very unwell for several days. During this period he had sensations as if electric shocks were passing through the body and limbs. He returned home, continued to feel unpleasant sensations in his head, back, &c., being often giddy, but was still able to take a certain amount of exercise, and even to ride on horseback. He continued in this unsatisfactory state until August 12, when he became suddenly extremely giddy and scarcely able to stand. His head became very confused, he could not attend to the business on which he was engaged, and seemed to have lost all energy and power. He continued to feel the electric shocks through the body. In November he began to suffer from an increasing difficulty about the lower extremities. He was obliged to leave off riding, as he had entirely lost both his grip and the power of balancing himself. He also found that he walked with difficulty, and occasionally seemed to lose control over his legs. On November 29, when getting up in the morning, he suddenly fell, and probably momentarily lost consciousness. He lost all power in his legs and suffered intense pain in the head. As he was gradually getting worse, he came up to London, when I saw him on January 6, in consultation with Mr. Calthrop. At this time he was complaining of various symptoms referable to the head, such as loss of memory, inability to attend to business, difficulty in grasping a subject. There was general debility, incapacity for exertion; he was unable to ride, could scarcely walk, looked haggard and ill, and felt himself a perfect wreck. On examining the body I found the following objective signs. There was flabbiness and wasting of the muscles of both the lower extremities and of the buttocks, the skin hanging loose. The left lower extremity was more shrunken than the right. The thigh at its middle was one inch smaller in circumference; the leg at the calf was three-fourths of an inch smaller than the right. There was a considerable diminution in the temperature of the limbs, especially of the left, which was very considerably colder than the right and the rest of the body. The electric irritability of the muscles was very materially diminished in both lower extremities; it was nearly lost in the left leg below the knee. In the upper extremities it was extremely active, the difference being very striking. The pulse was quick, varying from 100 to 110, and weak, the beats intermittent twice in the minute. On January 26 there was no improvement; in fact he was in more suffering, and had lost all power in the left leg. There was also a good deal of pain in the spine in the upper dorsal and lumbar regions, more especially on the left side. It gave him pain both to lie and to sit on the left side. He could not rise from a recumbent position without assistance from one or two persons, and could not dress without help. During this period he suffered much from pains in the head and ringing in the left ear. On April 27 I again saw him in consultation with Mr. Calthrop and Mr. Buller, when these symptoms were noted as continuing without any change. This state of things continued throughout the summer—the legs being cold and almost powerless, the pain in the head, the electric shocks, and inability to move remaining unaltered. On July 6 the symptoms continued without material change. He went to Yarmouth for change of air, but suffered intensely from the head, and derived no benefit. He continued under my observation for more than a twelvemonth, and after the termination of the legal proceedings, on February 18, 1867, he went into

the country. No material improvement took place in his condition for a very considerable length of time, and up to the present time there has been no recovery from the more serious symptoms.

Case 31. Railway Concussion—Injury to Cervical Spine—Meningitis—Permanent Injury—Paralysis and Irritation of Spinal Accessory, Musculo-Spiral, and Circumflex Nerves.—J. M. was injured in a railway accident on October 29, 1866. He suffered from the usual symptoms of spinal concussion, for which he was treated by Dr. Woodford, of Bow, with whom I saw the patient in consultation on November 30, 1867. At that time he presented three sets of symptoms of a very marked character, referable to the head, to the spine, and to the right arm. The head symptoms consisted of an inability to concentrate his thoughts, and of loss of memory on many points. In the course of conversation he 'dropped,' to use his own word, the thread of the discussion. There was a complete inaptitude for business. The spine was evidently the seat of very considerable mischief. It was rigid, moved as a whole when he was told to stoop, and was extremely painful on pressure and on movement in any direction, namely, in the lower cervical and in the middle and lower dorsal regions. The pain in this situation was described by the patient as being of a hot, burning character. From the seat of pain in the neck he suffered constant spasmodic pain shooting down the right arm and right side of the chest, with frequent cramps in the muscles of the arm. From the seat of pain in the dorsal region he complained of the sensation as of a cord being tightly bound round his body and pressing on his ribs. The right arm and hand had suffered considerably. There was great loss of muscular power in the limb, so that the patient was unable to hold it up in a horizontal position, or to support it extended for more than a few seconds. The grasp of this hand was much weakened, and considerably feebler than that of the left. The limb was wasted, more particularly below the elbow, where it was smaller than the left arm. The hand also was wasted, more especially about the muscles of the thumb. The patient complained of severe twitchings and spasmodic pains shooting down the fore-finger and the thumb. The attitude of the patient was very remarkable; he stooped forwards, and the right shoulder was raised about two inches higher than the left. This position was never changed. He suffered from severe spasmodic pains through the side of the neck and shoulder, and on examining the parts, the trapezius and sterno-mastoid muscles were found extremely tense. The muscles that were chiefly wasted in the right arm were those which are supplied by the musculo-spiral nerve. These muscles had lost their electric irritability. The raising of the right shoulder was evidently due to irritation of the spinal accessory nerve, in consequence of which the trapezius was kept contracted, and the spasms that passed through it were due to this irritation. The conclusions arrived at in connection with this case were that at the time of the accident there had been some concussion of the brain and of the spinal cord; that the brain was still suffering from the consequences of that concussion, but only to a slight degree; that the spinal cord had been severely injured; that there was evidence of chronic inflammation and irritation of it, these changes being seated in the meninges of the cord; that partial paralysis of the musculo-spiral nerve had already taken place; that the wasting of the limb and arm was dependent on the paralysis of this nerve; that in addition to the paralysis, the nerves of the brachial plexus were probably much irritated, as shown by the painful cramps that manifested themselves in the arm. The condition of the shoulder was due to spasm of the muscles supplied by the spinal accessory nerve. I saw the patient on February

LECTURE VI.

ON SPRAINS, TWISTS, AND WRENCHES OF THE SPINE.

SPRAINS, strains, wrenches and twists, of the spine are of very frequent occurrence. They may be followed by every possible kind of mischief to the vertebral column, its bones or ligaments, the cord or its membrane.

The symptoms indicative of lesion of the cord or its membrane may be immediate, or they may, as in many of the cases I have already related, come on slowly and progressively.

I will give you abundant illustration of both of these methods of development of symptoms.

It is important to bear in mind that the vertebral column is more apt to suffer in these strains of the spine than in the other forms of injury that we are discussing, and that in serious cases, as in the following, the full force of the mischief appears to be expended on the spine itself independently of its contents, which escape uninjured.

Case 32. Crush of the Spinal Column from Forcible Doubling Forward—No Permanent Injury to the Cord or its Membrane.—E. B., 26 years of age, was admitted under my care at the University College Hospital on February 8th, 1875. He stated that thirteen weeks ago, whilst working under a turn-table at a railway station, the table was accidentally turned upon him so that he was doubled forward underneath it. He suffered intense pain in the back, and was taken to a hospital, where he remained for a few weeks and was then discharged. When I saw him he presented the following symptoms. He could not stand upright, but bent forwards. He walked with difficulty and was unable to do so for more than half an hour at a time, on account of the pain that he suffered in the back, round the sides, and underneath the ribs. On examining his spine it was found that the spinous processes of the 10th and 12th dorsal vertebræ projected, whilst between them there was a distinct depression. The spinous process of the 11th dorsal vertebra was broken off and twisted out of the perpendicular so as to lie directly across towards the left side. On the right of this depression the muscular and tendinous structures could be felt under the skin loose. When lying on his back in bed the patient was unable to get up without using his hands to support himself. Both the lower extremities were wasted, but equally so. The sensibility of both legs was equal and appeared to be normal. The reflex irritability was also equal and normal. There had been no tinglings or other uneasy sensations in the limbs. On applying the secondary interrupted current, the muscular irritability appeared to be the same in the different groups of muscles, the extensors, the peroneals and the flexors in both legs. If there was any difference, which was doubtful, it appeared to be rather less in the extensors of the right leg, and the patient appeared not to be able to support himself quite so easily on the toes of the right foot as he could on those of the left. There was no paralysis of the sphincters, and no sensation as of a cord being tied round the body. This case illustrates in a remarkable manner the possibility of the existence of a fractured spine attended by displacement of bone, without any sign not only of paralysis, but even of meningeal irritation, and shows that the electric sensi-

bility and irritability of the lower limbs may continue perfect after such a severe injury.

Boyer relates a fatal case of wrench of the spine received in practising gymnastics, and Sir Astley Cooper gives an instance, to which I shall refer, of a fatal wrench of the spine from a rope catching a boy round the neck whilst swinging.

In two cases which I shall relate, the injury also arose from violence applied to the cervical spine; in one from a railway accident, in the other from a fall from a horse.

These wrenches of the spine are, from obvious reasons, most liable to occur in the more mobile parts of the vertebral column, as the neck and loins; less frequently in the dorsal region.

In railway collisions, when a person is violently and suddenly jolted from one side of the carriage to the other, the head is frequently forcibly thrown forwards and backwards, moving as it were by its own weight, the patient having momentarily lost control over the muscular structures of the neck. In such cases the patient complains of a severe straining, aching pain in the articulations between the head and the spine, and in the cervical spine itself. This pain closely resembles that felt in any joint after a severe wrench of its ligamentous structures, but is peculiarly distressing in the spine, owing to the extent to which fibrous tissue and ligament enter into the composition of the column. It is greatly increased by movement of any kind, however slight, but especially by rotation. The pains are greatly increased on pressing upon and on lifting up the head, so as to put the tissues on the stretch. In consequence of this, the patient keeps the neck and head immovable, rigid, looking straight forwards—neither turning to the right nor to the left. He cannot raise his head off a pillow without the assistance of his hand, or of that of another person.

The lumbar spine is often strained in railway collisions, with or without similar injury to the cervical portion of the column, in consequence of the trunk being forcibly swayed backwards and forwards on the pelvis during the oscillation of the carriage on the receipt of a powerful shock. In such cases the same kind of pain is complained of. There is the same rigidly inflexible condition of the spine, with tenderness on external pressure, and great aggravation of suffering on any movement, more particularly if the patient bends backwards. The patient is unable to stoop; in attempting to do so, he always goes down on one of his knees.

These strains of the ligamentous structures of the spinal column are not unfrequently associated with some of the most serious affections of the spinal cord that are met with in surgical practice as a remote consequence of its injury.

They may of themselves prove most serious, or even fatal. Thus, in Case 34, we have an instance of loosening of the cervical portion of the spinal column to such an extent that the patient could not hold the head upright without artificial support.

In Case 35 we have an example of inflammatory swelling developing around the sprained part to such an extent as to compress the cord and spinal nerves, and thus lead to paralysis. And lastly, in Sir A. Cooper's case, we have an instance of a sprain of the spine terminating in death, and a description of the post-mortem appearances presented by this accident.

The *prognosis* will depend partly on the extent of the stretching of the muscular and ligamentous structures, partly on whether there is any inflammatory action excited in them which may extend to the interior of the spinal canal.

As a general rule, where muscular, tendinous, and ligamentous struc-

tures have been violently stretched, as in an ordinary sprain, however severe, they recover themselves in the course of a few weeks, or at most within three or six months. If a joint, as the shoulder or ankle, continues to be weak and preternaturally mobile, in consequence of elongation of the ligaments, or weakness or atrophy of the muscles, beyond this period, it will, in all probability, never again be so strong as it was before the accident.

The same holds good with the spine; and a vertebral column, which, as in Case 34, has been so weakened as to require artificial support, after a lapse of eleven months, in order to enable it to maintain the weight of the head, will not, in all probability, ever regain its normal strength and power of support.

In strumous or delicate constitutions sprains or wrenches of the spine will frequently lay the foundation of serious organic disease of the bones and articular structures, leading to angular curvature of the spine, with abscess, paraplegia, and possibly ultimately a fatal result. The following case is one of many that I have seen illustrative of these facts.

Case 33. Wrench of Spine in Hunting—Gradual Supervention of Angular Curvature—Paraplegia—Partial Recovery—Second Accident—Large Abscesses and Death.—C. D., aged 21, was seen by me in consultation with Mr. Hey, of Leeds, in April 1869. He was a slender active young man, much given to athletic exercises. One year previously, in April 1868, whilst hunting, his horse suddenly went into a hole. The patient was looking round at the time, and, in order to prevent being thrown, made a violent effort. He felt at the time that he had given himself a severe wrench in the left side, close to the middle of the back; but no sign of paralysis or of any injury to the nervous system was manifested. He was obliged, however, to lay up for some months, and was kept quiet by order of his medical attendants. In the course of the summer he lost the pain at the seat of injury, and gradually recovered his health. In the autumn he went to Whitby, where he rode, played at cricket, ran races, danced; in fact, indulged in all those exercises and sports that were natural to his age and consonant with his disposition. He continued much in this state until Christmas 1868, when he became rather suddenly paraplegic, without pain, cramps, or any sign of meningeal or spinal irritation. He was obliged to lie by, the paraplegia of the lower limbs being complete. When I saw him at Ilkley, in consultation with Mr. Hey and Dr. Call, I found that there was complete loss of motive power in the lower extremities; sensation also was greatly diminished, if not entirely abolished. The sphincters were not affected; he passed his urine voluntarily; it was acid. He could not restrain, although he could feel, the passage of his motions. There was considerable excurvation of the sixth, seventh, and eighth dorsal vertebrae, the seventh being very prominent. There was no tenderness, however, or sign of abscess anywhere. The conclusion that we came to was, that in consequence of the wrench of the spine there was dry caries of the body of the seventh dorsal vertebra, and the cord was compressed at this situation. He was ordered small doses of the perchloride of mercury, caustic issues or the actual cautery to the side of the spine, the prone position, and to take cod-liver oil and good diet. Under this treatment he gradually recovered. In May 1871 he was able to come up to London. He walked well, and was quite free from all paralytic symptoms. He was able to walk three or four miles, could stand and hop on one leg. He complained of occasional spasmodic and involuntary twitches in the legs, and of some stiffness in one knee. There was no trouble with the bladder or rectum, but the bowels were constipated, and he had loss of sexual desire and power. The excurva-

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There was no pain in the cervical spine, nor could any irregularity of

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There was no trouble with the bladder or rectum, but the bowels were constipated, and he had loss of sexual desire and power. The excurva-

tion of the spine continued, but there was no tenderness on pressure or pain on moving the vertebral column. Unfortunately, he was some time afterwards thrown out of a dog-cart, in consequence of which he sustained a fresh injury to his spine; an abscess, which I opened in April 1873, developed, and he eventually died in May of the same year, from exhaustive and irritative fever, consequent upon extensive suppuration.

One great prospective danger in sprains of the spine is the possibility of the inflammation developed in the fibrous structures of the column extending to the meninges of the cord. This I have several times seen occur, and I believe that this happened in some of the cases I have recorded. We see that this is particularly apt to take place when the sprain or twist occurs between the occiput and the atlas or axis. In these cases a rigid tenderness is gradually developed, which is most distressing and persisting and evidently of an inflammatory character. Or, as in Case 31, the paralysis may remain incomplete, being confined to the nerves that are connected with that part of the spine which is the seat of the wrench, one or other of their roots either having suffered lesion, or the nerves themselves having been injured in their passage through the intervertebral foramina.

Lastly, as in Sir A. Cooper's case, a twist of the spine may slowly and insidiously be followed by symptoms of complete paraplegia, and eventually by death from extravasation of blood into the vertebral canal.

Case 34. Severe Strain of Cervical Spine—Paralysis of Left Arm—Long-continued Weakness of Neck.—Miss —, a lady, 28 years of age, was involved in a terrible catastrophe that occurred on June 9, 1865, when, in consequence of a bridge giving way, a portion of a train was precipitated into a shallow stream. This lady lay for two hours and a half under a mass of broken carriages and débris of the bridge, another lady, a fellow-passenger, who had been killed, being stretched across her. Miss — was lying in such a position that she could not move. Her head was forcibly twisted to the right side, and the neck bent forwards.

When extricated she was found to be a good deal cut about the head and face, and the left arm was extensively bruised, ecchymosed, and perfectly powerless.

Her neck had been so violently twisted or wrenched that for a long time Miss — lost completely all power of supporting the head, which she said felt loose. It used to fall on any side, as if the neck was broken, usually hanging with the chin resting on the breast.

Without going unnecessarily into the minute details of all the distressing symptoms with which this young lady was affected, it will suffice to say that she gradually recovered from all her general bodily sufferings, except these conditions, viz., a weakened state of the neck, a loss of power in the left arm; and pain in the lower part of the back.

The neck had been so severely twisted and sprained that the ligamentous and muscular structures seemed to be loosened, so that in order to keep the head in position she was obliged to wear a stiff collar lest the head should fall loosely from side to side. At first it had a special tendency to fall forwards; but after a time the tendency was in a backward direction. When lying on her back she had no power whatever to raise her head, and to do so was obliged to put her right hand under it so as to support it. If she wished to get up when in bed, for instance, she assumed a most distressing action, being compelled to roll over on to her face, and then, pressing the forehead against the pillow, to get upon her knees.

There was no pain in the cervical spine, nor could any irregularity of

the vertebræ be detected. There was no pain in forcibly moving the head on the atlas, or rotating this bone on the axis. The looseness appeared to be in the lower part of the cervical spine.

The left arm at first and for many weeks afterwards was completely powerless, all sensation as well as power of motion in it having been lost. Sensation gradually and slowly returned. But the whole of the nerves of the brachial plexus appeared to be partially paralysed, so far as motor influence was concerned. The circumflex, the musculo-spiral, the median and the ulnar nerves were all affected to such a degree as to occasion great loss of power to the muscles they respectively supplied. Thus she could not use the deltoid so as to raise the arm to the top of the head. She could not pick up a pin or even a quill between the thumb and forefinger. She could not hold a book. The power of grasping with the left hand and fingers was infinitely less than that with the right, and there was some rigid contraction of the little and ring fingers. The muscles of the left hand and of the ball of the thumb were wasted.

This crippled and partially paralysed state of the left arm was a most serious and distressing inconvenience to the patient. Before the accident she had been an intrepid rider, a skilful driver, and an accomplished musician, playing much on the harp and piano. All these pursuits were necessarily completely put a stop to, and from being remarkable for her courage she had become so nervous that she scarcely dared to ride in a carriage.

Mr. Tapson had most skilfully and assiduously attended this very distressing case almost from the time of the accident, and the patient had occasionally had the advantage of Mr. Holmes Coote's advice. When I saw Miss — in consultation with these gentlemen on April 20, 1866, ten and a half months after the accident, they told me that the condition of the neck had certainly, though very slowly, improved, but that the state of the left arm, which was such as has just been described, had undergone no change for several months.

The pain in the lower part of the back had increased during the last two months. There was no disturbance of the mind, and no sign of cerebral irritation. The bodily health generally was fairly good—as much so as could be expected under the altered circumstances of life that this accident had in so melancholy a manner entailed on this young lady.

The state of the cervical spine in this case was most remarkable. It was movable at its lower part in all directions as if it were attached to a universal joint, or had a ball-and-socket articulation, the weight of the head carrying it in all directions. It was almost impossible to conceive so great a degree of mobility existing without dislocation—but there was certainly neither luxation nor fracture, the vertebræ being apparently loosened from one another in their ligamentous connections and their muscular supports, so that the weight of the head was too great for the weakened spine to carry.

This loosening was most marked in the lower cervical region, and did not exist between the atlas and the occiput. It was clearly the direct result of the violent and long-continued wrench to which this part of the spine had been subjected.

The paralysis was confined to the left arm, no other part of the body having been affected by it. At first the paralysis was complete, the arm being perfectly powerless and sensation being quite lost. After a time sensation returned, but motion was still very imperfect, and no improvement had taken place in this respect for several months. As the nerves of the whole of the brachial plexus were implicated, and apparently to

the same degree, it was difficult to account for this in any other way than by an injury inflicted upon them at their origin from the cord, or in their exit through the vertebral column. I think it most probable that this latter injury was the real cause of nervous weakness to the left arm, for the spine had been wrenched in the lower cervical region, in that part, in fact, which corresponds to the origin of the brachial plexus, and there was not at the time of my visit, nor did there appear to have been at any previous period, any disturbance in the functions of the spinal cord as a whole; the paralysis being entirely and absolutely localised to the parts supplied by the left brachial plexus, implicating these only so far as motor power was concerned, and affecting no other portion of the nervous system.

Case 35. Fall on Head—Twist of Cervical Spine—Gradual Paralysis of Whole of Body—Slow Recovery.—The following case, which I have seen several times in consultation with Dr. Russell Reynolds, under whose immediate care the patient was, and to whom I am indebted for its early history, affords an excellent illustration of some of the effects that may result from a severe twist or wrench of the spine.

Mr. G., about 23 years of age, a strong, well-formed, healthy young man, was thrown from his horse on December 12th, 1865. He fell on the back of his head, on soft ground, and rolled over. He got up immediately after the fall and walked to his house, a distance of about one hundred yards. He had no cerebral disturbance whatever, being neither insensible, delirious, concussed, nor sick. The head was twisted to the left side, and he felt pain in the neck. He kept his bed in consequence of this pain in the neck till January 1st, 1866, and his room for a week longer. At this time he tried to write, but found great difficulty in controlling his right arm. He managed, however, to do so, and did write a letter. He was under surgical treatment in the country, and was not considered to have paralysis, as he could use his arms well for all ordinary purposes, and could walk without difficulty.

Towards the end of January, nearly six weeks after the accident, symptoms of paralysis very gradually and slowly began to develop themselves. The right arm became cold, numb, and was affected by creeping sensations. His right leg became weak, unequal to the support of the body, and he dragged his right foot.

He came to town on February 21st, when he was seen for the first time by Dr. Reynolds, who reports that at this period the paralysis of the right arm had become complete, while that of the right foot was partial, the patient walking with a drag of the foot. His limbs gave way under him, so that he had occasionally fallen. He had no pain in any part of the body; his mind was clear, but he was very restless.

On the 27th February, whilst stooping he fell in his bedroom, struggled much, and was unable to rise. He was found, after a time, lying partly under his bed. On the following day, it was found that the left side was partially paralysed, the right side continuing in the condition already described. There was now considerable swelling and tenderness on the left side of the neck and about the third and fourth cervical vertebræ. He was seen shortly after this by Sir William Jenner, in consultation with Dr. Reynolds, and was ordered complete rest, with large doses of the iodide of potassium.

I saw him on March 3rd, in consultation with Dr. Reynolds. I found him lying on his back in bed. The mind quite clear; spirits good. No appearance of anxiety or distress in the countenance; in fact I was much struck by the happy, cheerful expression of his countenance under the melancholy circumstances in which he was placed.

I found his condition much as has been described. There was com-

plete paralysis of the right arm and partial paralysis of the right leg. The left arm was also partially paralysed, and the left leg slightly so. He was unable to stand. There was no affection of the bladder or of the sphincter ani. The skin was hot and perspiring; the pulse quick; the urine acid.

He could not raise his head off the pillow, and lay quite flat on his back. On being raised up in the sitting posture, it was necessary to support his head with the hands; and when he was seated upright, he held the head firmly fixed, the spine being kept perfectly rigid. He was quite unable to turn or move the head.

The back part of the neck was swollen, especially on the left side; and was tender on pressure. The swelling was less than it had been. The cervical vertebræ felt as if they were somewhat twisted, so that the head inclined towards the right side. It was doubtful whether this was really so. The patient continued the iodide of potassium, and a gutta percha case, extending from the top of his head to the pelvis, and embracing the shoulders and back of the chest, was moulded on him, so as to keep the head and spine motionless. He was ordered to lie on his back, and not to move.

I saw the patient several times with Dr. Reynolds, and we were gratified to find that a steady improvement was taking place. On March 27th, he had completely lost all symptoms of paralysis on the left side of the body; the right leg had recovered its power, and the paralytic symptoms had almost entirely disappeared from the right arm. He could raise it, grasp with his hand, and in fact use it for the ordinary purposes of life. He could stand, though in a somewhat unsteady way. This seemed owing rather to his having kept the recumbent position for so long a time than to any loss of nervous power in the legs.

The swelling of the neck had entirely subsided, and the cervical spine was straight, but it was rigid, and he could not turn the head. The support was habitually worn, and gave him great comfort.

This case is remarkable in several particulars. In the first place, the fact that the paralysis did not begin to show itself until many weeks—nearly six—had elapsed from the time of the accident is a matter of the greatest consequence in reference to these injuries. Then again, the fact that although the brain was throughout unaffected, and the injury purely spinal, the paralysis was of a hemiplegic and not a paraplegic character, is also not without import. And lastly, the gradual subsidence of the very threatening symptoms with which the patient was affected, and the disappearance of the paralysis of the limbs in the inverse order to that in which it developed itself in them, should be observed.

That wrenches or twists of the spine may slowly develop paralytic symptoms, and may be attended eventually by a fatal result, is well illustrated by a case recorded by Sir Astley Cooper as occurring in the practice of Mr. Heaviside. It is briefly as follows:—A lad, 12 years old, whilst swinging in a heavy wooden swing, was caught under the chain by a rope, so that his head and the whole of the cervical vertebræ were violently strained. As the rope immediately slipped off, he thought no more of it. For some months after the occurrence he felt no pain or inconvenience, but it was observed that he was less active than usual, and did not join in the games of his schoolfellows. At that time it was found that he was really weaker than before the accident. He suffered from pains in the head and in the back of the neck, the muscles of which part were stiff, indurated, and very tender to external pressure. Movement of the head in any direction gave rise to pain, and there was diminution in voluntary power of motion in his limbs.

Eleven months after the accident the paralytic affection of the limbs was gradually getting much worse, in addition to which he felt a most vehement and burning pain in the small of his back. His symptoms gradually became worse, difficulty of breathing set in, and he died exactly twelve months after the accident.

On examination after death the whole contents of the head were found to be perfectly healthy. There was no fracture or other sign of injury to the spine, but 'the theca vertebralis was found overflowing with blood which was effused between the theca and the inclosing canals of bone. The effusion extended from the first vertebra of the neck to the second vertebra of the back, both included.'¹

This case is a most valuable one. It illustrates one of the important points in that last described, viz., the very slow, gradual, and progressive development of paralysis in these injuries of the spine. And as it was attended by a fatal issue and the opportunity of a *post-mortem* examination, it also proves that this slow and progressive development of paralysis after an interval of 'some months' may be associated with extensive and serious lesion within the spinal canal, with the effusion, in fact, of a large quantity of blood upon the membranes of the cord,—the very condition that has already been shown (p. 69) to be the common accompaniment of many fatal cases of so-called 'Concussion of the Spine.'

Each of these cases of twist of the spine is typical of a special group of these injuries. In the first we have sudden and immediate paralysis of one arm produced by the wrench to which that portion of the spine that gives exit to the nerves supplying that limb had been subjected.

In the second we have paralysis, resulting after an interval of some weeks, as a consequence of the pressure of the secondary inflammatory effusions that had been slowly produced by the injury to the spine and its contents,—that paralysis disappearing as these effusions were absorbed.

In the third case we have an instance of death resulting in twelve months after a wrench of the spine by the effects of hæmorrhage into the spinal canal.

The following cases will illustrate many of the points to which I have drawn special attention in this Lecture.

I saw the following case in November 1866, in the London Hospital. It illustrates well the rapid supervention of paraplegia from a twist or wrench.

Case 36. Sudden Twist of Spine—Paraplegia.—J. H., aged 44, an iron founder, six weeks before, whilst standing in a constrained attitude inside the mould of a casting, and engaged in throwing out some heavy shovelfuls of sand in a way that required much twisting of the body, suddenly experienced a sensation in his back which he likened to a snap of the fingers. He did not fall down, but was able to continue his work till the evening without difficulty, although he said that about an hour after the event he was walking home, and felt a 'swimminess' in his legs for a moment, and as if he would fall. He went to bed early in the evening, and when he tried to get up the following morning, he found he had lost all power over his legs and all sensation in them, being unable to rise out of bed or to stand, which he had not been able to do since. Fæces and urine passed involuntarily and without his knowing it. There was now no power of motion in either foot, reflex movements were also absent; sensation was absent in both legs and in the trunk to about the level of the umbilicus. On the inner side of the sole

¹ Sir A. Cooper, *Fractures and Dislocations*, 8vo ed., p. 530.

of the left foot, however, he could still feel. The left arm, he said, became numb if he let it remain still for any length of time. Its temperature was about half a degree lower than that of the right.

The urine was alkaline, had a very ammoniacal odour, effervesced strongly on the addition of nitric acid, had a deposit which disappeared partly on the addition of nitric acid (phosphates); the part which did not dissolve having the appearance of mucus.

There was no pain on pressing the hand down the vertebral column.

He left the Hospital at the end of the following March. Mr. Adams kindly informed me that there was not much improvement in his paralysis. He was, however, just able to move his toes and feet very slightly, but was utterly unable to stand. His water dribbled away, and his fæces passed involuntarily, though with some irritation.

The next case is a very similar one of rapid supervention of paraplegia, after a strain of the spine in a railway accident.

Case 37. Wrench of Spine from Railway Accident—Symptoms not immediate—Paraplegia—Phlebitis—Eventual Recovery.—Miss A. B., aged 22, a young lady of remarkable personal beauty, tall, strong, and well formed, in excellent health, who, to use her own expression, could 'ride all day and dance all night,' without feeling fatigued, met with the following accident.

Whilst travelling on the London and North Western Railway, on December 26, 1865, the carriage in which she was seated came into collision with some obstruction on the line and was turned over. Miss ——— was violently shaken, bruised about the knees and legs, but received no blow upon the body. She felt a sudden wrench or twist in the lower part of the spine, and according to the statement of her fellow-passengers, called out, 'Oh! my back is broken!' She was, however, unconscious of the exclamation. After being extricated from the overturned carriage, she was able to walk, and sat down upon the embankment, feeling no pain, but rather stiff. In the evening she found a difficulty in moving the legs. The next morning she was unable to stand, and from that time she was paralysed in both lower extremities. The paralysis was almost complete so far as motion was concerned. The only motor power left consisted in moving the toes to a limited extent, and the foot or the ankle very slightly. She could not raise either limb, nor had she the slightest power of supporting herself or standing. Sensation was little if at all impaired, but there was rigidity of the muscles of the legs. The pelvic organs were not affected.

There was severe pain on pressure and on movement, opposite the second and third lumbar vertebræ, especially if the body was bent backwards. The pain extended towards the left side of the pelvis, but existed nowhere else.

About six weeks after the accident, the veins of the left thigh became obstructed by thrombosis, the limb swelled and became œdematous, and the general health suffered very seriously.

This young lady was seen by several surgeons. The treatment that was adopted was chiefly complete rest on a couch, and alterative and tonic medicines. She continued in much the same state, with little if any change in the symptoms, until October 1866, when she came more completely under my care than she had previously been. I now ordered her repeated blistering to the tender part of the spine, and put her on a course of small doses of the perchloride of mercury in bark. Under this plan of treatment she began to improve, so much so that she could bend the knees, draw up the legs, and move the feet more freely.

In the early part of 1867, a spinal support was fitted on, so as to remove pressure from the spine and uphold the trunk. The blistering

was continued, and iron and strychnine substituted for the other remedies.

She was sent to Brighton, where for months she was confined to the recumbent position, but was taken as much as possible into the open air on a wheel couch. This treatment was continued till February 1867, when she was able to sit up, and a few months later to stand upright by leaning on to the back of a chair. From this time she slowly but progressively recovered. By July 1868 she was quite well, and has remained so ever since. I give the next two cases *in extenso*, as taken from the Hospital Case Books.

Case 38. Severe Wrench of Cervical Spine—Paralysis—Recovery.—W. H., aged 22, London, admitted into University College Hospital November 21, 1868. The patient had the same day fallen out of the front of a van, and was 'rolled up by the axle,' though the wheel did not pass over him. He did not feel much pain, but experienced a strain or twinge at the lower part of the neck behind. He was carried away quite sensible to the Hospital, not feeling pain, but numbness, extending downwards from the lower hinder part of the neck to the feet.

On admission the patient was perfectly conscious. He had lost all sensation in his arms, legs, and in the trunk below the third rib. His limbs were powerless. When the patient was put in bed and his neck examined, there was great tenderness on pressure over the (?) fourth cervical vertebra; in this situation there was unusual prominence. There was retention of the urine, and paralysis of the sphincters. Patient was put on a mattress, his head on same level as his body. A catheter was passed.

Nov. 22nd.—Patient can move his right leg about, also his left arm, but the right arm only slightly. Cannot clench his fist. Deficient sensibility in his limbs and trunk. Ordered a simple enema, which was retained. The deltoid and biceps of the right arm act, but the triceps and muscles of the forearm and hand do not. The flexors and extensors of the arm, and the extensors of the forearm of the left side act, but the other muscles are useless.

23rd.—Sensation not yet natural, his chief pain is in his right shoulder. When he moves his head he has pains shooting down the legs and right arm. Complains of tingling in the thumb and two outer fingers of both hands, extending towards the wrist. In the other fingers there is numbness.

24th.—Great pain is caused if the right arm is brought forwards over the chest, and there is semi-priapism.

Back of patient beginning to feel sore.

A large splint was applied to the back to support his head.

25th.—Patient feels better. Total loss of voluntary power in lower extremities. Some slight reflex action on tickling the soles of his feet. Complains of hot sensations running down his right arm. The back is getting worse, and a bed-sore is forming.

26th.—Last night patient had an enema. This was retained. This morning had one ounce of castor oil. His bowels were freely opened and he felt better.

No return of voluntary motion in the legs.

28th.—Patient is able to move his legs very slightly, raises his knees a little off the bed; right more than left. If he moves his head, the same shooting pains are still felt in the right arm. He complains most of his back. Was put on an air-bed to-day.

29th.—Patient moves his right arm more easily. Extension is gradually getting easier. Voluntary motion has increased in left arm.

30th.—Voluntary motion has improved in the legs. He can raise the knees better ; right more than left. Sensibility has improved.

Dec. 2nd.—Yesterday an enema was ordered, and not retained. Patient can now flex the hip and knees to a considerable extent. Can also move the left leg, but not to the same extent.

Cannot pass his urine yet.

The priapism is subsiding. There is pain in the lower part of the abdomen.

4th.—Patient has gradually regained the power of moving his legs.

To-day, for the first time, his urine contained blood.

6th.—Hæmorrhage from the bladder still continues, though to a less extent.

Incontinence of urine is now present.

10th.—Mobility of lower extremities and arms, more especially the left, improving.

Incontinence of urine still continues.

Hæmorrhage less.

11th.—Patient quite conscious of his water passing away from him. Other symptoms the same.

12th.—On account of the great spasm caused by the passage of the catheter, morphia had to be injected hypodermically to relieve it, and this it did effectually. This also relieves the pain at the lower part of the abdomen.

13th.—Morphia injection still used before washing out the bladder.

17th.—Up to to-day the bladder has been washed out every other day.

The urine has gradually improved ; it is of its natural colour to-day. The hæmorrhage has ceased. Patient can now retain his water for a short time, a quarter to half an hour, and is beginning to regain the power of passing his urine to a slight extent. Still some incontinence.

18th.—Bladder washed out after a previous hypodermic injection of morphia. Partial control over the sphincters of the bladder and anus. No pain anywhere.

19th.—Patient can now move right leg freely. Less movement of left, for although he can adduct the thigh he cannot flex the hip.

His urine has always been very fetid, alkaline, and full of mucus.

23rd.—Patient has some pain at the lower part of the abdomen. Urine the same.

24th.—Pain in abdomen has increased. Bowels confined. Tongue furred.

26th.—Pain somewhat better in abdomen. Bowels open last night ; very constipated.

This morning the urine is not so fetid.

His general condition to-day is :—Partial paralysis of the right arm. The movements of this limb being slight attempt at supination ; the arm being always kept pronated on his chest, he can just raise the hand off the chest and then twist it round till it attains the perpendicular ; he cannot supinate it more than that. Any attempt to extend the arm passively or to supinate it forcibly gives him pain.

The left leg is in a similar condition to the arm ; he can draw his leg and thigh up, but he cannot raise his heel off the bed. The constant irritation of the urine about the scrotum has made this red and excoriated. The bed-sore on the back is getting better.

9 P.M. Patient has been very merry, and felt free from pain all day, but now he is in a low, depressed, semi-hysterical state, his pulse beating quickly and jerking. On enquiring into the cause of this, he said that he had just been dreaming how he was placed on a board very nicely balanced on the parapet of Waterloo Bridge, and he was making

most violent efforts to save himself when he woke up. He says that since the accident he is very subject to these horrid dreams, which generally leave him in the state he was then found. The pain at the lower part of the abdomen is worse. Bowels confined. Skin hot. Tongue dry, furred; great thirst. Temperature 100°; pulse 100.

31st.—Urine decidedly improving; not so thick or fetid as it has been. Patient can hold his water better.

The paralysis has not materially improved; bed-sore nearly well.

Temperature 9 P.M. 98.5 (between thigh and scrotum). Appetite very good.

Jan. 7th.—Patient has materially improved since last report; so far as the urine is concerned, this is not fetid, or very little so. No mucus in it except when drawn off with a catheter, then the last drops contain a few shreds of mucus; no blood.

He can hold his water for two hours at a time. The bladder only requires to be washed out every other day, and sometimes only every fourth day. He still has the spasms when the catheter is introduced.

He can raise his left heel a little (1 in.) off the bed. Sensation almost equal in both legs. On the inner side of the left tibia is a small neuroma about the size of a cherry-stone. It came on some years ago, after a cut on the leg. The tumour is just about half an inch above the cicatrix of the wound. It is somewhat tender on pressure, not painful otherwise.

He can move his head about without pain. There is no tenderness over the seat of injury in the neck.

His general appearance has undergone a change for the better, he looks more cheerful, and is getting stronger and stouter.

Feb. 13th.—Patient can now move his legs about quite freely, and when he extends the knees forcibly I cannot bend them; the same with the ankle. There is therefore *very* marked improvement so far.

He uses his arms quite freely, the right is still weaker than the left.

Sensibility restored over whole body.

Reflex action perfect in both legs.

The bladder has very much improved, although not so much as the legs. He can now hold his water for several hours. Catheterism is no longer required, and the urine is perfectly normal.

He can sit up in bed without support, but does not get out of bed yet.

His bed-sore is quite well.

Appetite good; bowels regular; tongue clean.

March 3rd.—Patient allowed to get up for the first time to-day, still wearing the apparatus. He can now walk with assistance; can move his head and neck freely. Sensation is complete. Motion and power in the arms perfect. No pain or other abnormal sensations. Urine normal. Micturition still somewhat frequent.

Some phosphatic deposits having formed in the bladder, these were removed by the dissolvents, to the great comfort and advantage of the patient.

From this time he gradually but slowly improved. He was made an out-patient, and continued to attend the Hospital for the next three or four years, very slowly mending. When suffering from a relapse, he always came to ask for a bottle of the perchloride of mercury. When I last saw him, about a year ago and five years from the time of the accident, he was fairly well; able to do light work, and walk moderately; but he suffered from headaches and weakness of the limbs.

Case 39. Wrench of Spine—Relief—Relapse—Incurable Meningo-Myelitis.—J. H., aged 28, shipwright at Sheerness, admitted into University College Hospital May 4, 1867. Patient was a tall, well-built

man, somewhat worn-looking and emaciated, but not greatly so. He stated that he was stout and very well before the accident.

On April 15, patient, with three other men, was carrying a beam (20 ft. long by 9 in. square). The two men at the farther end let it fall suddenly, so that H. and his mate had to support most of its weight, and received a violent jar, but no blow. Being the taller of the two men, he received most of the shock. He felt faint at the time but did not fall. He walked home at once (about a quarter of a mile). Soon after he got home he felt severe pain in the lower dorsal region and all round the upper part of the abdomen. It hurt him to breathe. At the back of his head he had a severe stabbing pain. For four days he had retention of urine (which was very thick), and he passed, for a few days, occasional clots of blood in his stools. Two days after the accident he had a numb feeling in his legs below the knees, and a feeling of coldness in the calves, but he had always been able to move his legs. States that his urine and motions used to escape involuntarily.

The treatment had been expectant. Liniments and rest, no cupping or blisters.

On admission patient stated that he suffered from giddiness, and had shooting pains up the back to the occiput. He could not see so well as previously; on reading, the letters 'jumped about,' and specks, black and white, always floated before his eyes. Hearing and speech unaffected.

On examination the spine was found to be exceedingly tender on pressure, from the ninth dorsal vertebra to the end of the sacrum. Pressing the spine occasioned a spasmodic movement of the abdominal muscles and legs. There was also some tenderness at the fourth dorsal vertebra, and pain round the thorax at that level. Sensation in the legs below the knees was greatly impaired. Lying in bed, he was able to raise the right foot slightly, but had no power over the left. Could just manage to walk, but in a hobbling manner. He had now slightly defective power over the sphincters.

Urine was now healthy. Bowels acted very irregularly. Slept badly, but did not dream much.

May 7th.—Patient complains to-day of cramps in the calves of his legs, which he has not had before. Can stand on one leg, but for a few minutes only. Bowels now open. Sleeps fairly. Appetite tolerable.

8th.—I saw him and ordered one grain of calomel with half a grain of opium every six hours, dry cupping to the spine, to be followed by fomentations.

9th.—He has been greatly relieved by the dry cupping. Bowels open. He still complains of great tenderness down the spine on pressure.

15th.—Patient continues to improve. The dry cupping has been repeated. Power over bladder, and sensation and motion in the legs improves.

17th.—Mouth rather sore. Pills to be taken less frequently. Blisters to be applied every four or five days down the spine.

19th.—Much better. Sensation and motion in the legs much increased.

27th.—Much improved. Sensation in the legs now normal. Can raise them both from the bed with ease. Pain in the back nearly gone. Blistering continued.

30th.—Seems almost well. Has no pain whatever in the back, and touching the back causes no spasm. Has complete power over the bladder and the rectum, and can walk steadily, and stand on one leg, though rather shakily on the left. He only complains of 'fluttering sensations in the inside.'

June 4th.—Continues to improve. Gets up every day. He now complains of the light, and says he has a headache, and a tender spot in the loins. To keep in bed.

8th.—States that he feels all right again. Headache gone, and also the tender place. To get up again.

17th.—Going on perfectly well. No change since last report.

Discharged convalescent.

March 23, 1868.—Patient presented himself again to-day. Since leaving the Hospital he thinks he has been getting gradually worse. In October last he tried to work, but was so much worse in consequence that he had to go into St. Bartholomew's Hospital, Chatham, where he remained for three weeks. Since then he has been getting worse. Complains of numbness in his legs. Sensation perfect in both legs above the knee, defective below; firm pressure being felt, but not slight pressure. Cannot recognise which toe is pinched, but thinks that when the great toe is pressed it is the second one. He can walk about half a mile; then his legs tremble and he can walk no further.

He complains of constant pains in the head (occipital region), and also severe occasional pains in the groins, the pain shooting round from the spine. His urine is 'muddy' when it passes. He cannot hold it longer than two hours. Bowels obstinately confined. Sight worse of late. There is a constant dimness before him, and when he reads the 'lines run into one another.' His hearing, he says, is gradually getting worse. He describes his mind as in a state of 'constant confusion.' Memory very bad. Sleeps badly at night, and is always dreaming.

Pulse 96, feeble. Appetite bad. Tongue coated with a white fur.

Ordered to take small doses of perchloride of mercury in decoction of bark, and to have complete rest.

The patient continued for some length of time in the Hospital, but deriving no material benefit was discharged as incurable.

Case 40. Strain of Back—Slowly Progressive Symptoms—Gradual Development of Cerebral Symptoms.—D. S., aged 54, consulted me November 7, 1871. He stated that three years before, whilst lifting a heavy box, he felt that he had strained his back across the loins. He was seized with pain in this region and a sense of weakness, so that he was obliged to put down the box at once. From that time he was never well; he had become weak, unable to walk as he did before, and without being able to define any precise ailment, stated that he had not felt as he did before the injury. He had become thinner, especially in the legs, and always felt a weakness and a pain across the back. About four months before I saw him he first began to complain of head symptoms.

The following are the notes taken of his condition when he came to me:—He is generally weak. He complains of pain across the forehead, sleeps badly, dreams much. He cannot employ his mind in business matters or reading, as he did before the accident. His sight has become impaired, and he has a benumbed and tingling feel in the legs. The head is hot; appetite bad; pulse quick and feeble. On examining the spine, considerable tenderness on pressure was found over the second lumbar vertebra, with pain in moving the body to and fro, or laterally.

This case presents an instance of the gradual development of cerebral symptoms, two and a half years after an indirect injury to the lumbar spine. Doubtless owing to the extension upwards of meningeal irritation.

Case 41. Strain of Back in Wrestling—Slowly Progressive Symptoms—Spinal Anæmia.—A. B., aged 27, January 14, 1875. In May 1870,

whilst wrestling, strained his back ; did not suffer much at the time, but on following night had much twitching in the legs and arms. Was incapacitated for any work for almost a year ; during the greater part of this time was unable to walk any distance round the garden, or half a mile at most. Scarcely got better, but to a certain extent was able to enter upon practice as a medical man, but not to do any very hard work. But latterly had been getting weaker and suffered more from fatigue.

He now complained of dulness of head, at times confusion of thought. Pains at back of head on reading. Sleeps heavily ; dreams much. Sensation affected. Feels extreme weakness in the spine and legs ; not a sense of pain, but one of exhaustion down spine. No pain except feeling of uneasiness over seventh cervical vertebra. Sexually weak, no desire or power. No affection of sphincters ; cold extremities ; looks old and worn. Treatment consisted of iron and quinine, with the continuous current to the spine and cold douches to the back.

Case 42. Strain of Lumbar Spine in a man previously injured by fall from horse—Long Persistence of Symptoms.—T. T., aged 38, was sent to me by Mr. Hooker, of Tunbridge, on May 7, 1869. Two and a half years previously he had been thrown from his horse and dragged some distance, the lower part of the back being much bruised by the accident. He was laid up for about a fortnight, and lost power in the right leg. There was at no time any affection of the sphincters. He gradually improved up to a certain point, where he remained stationary. He complained of weakness in the back, of numbness and darting pains in the right leg, and especially of cold. He also experienced a clutching sensation in his back, in consequence of which he had not been able to ride since the accident. Last December, whilst lifting a heavy weight, he felt that he had strained his back, suddenly dropped and fell to the ground, owing to his legs giving way under him. Both the lower extremities became numb, and he suffered very severe pains, 'fearful pains,' through them. He was obliged to lie on the floor of the dining room for five days, not being able to move, owing to the excessive pain which was induced on any attempt to raise him. He gradually but very slowly improved until he was able to get about on crutches. There still remains considerable tenderness in the lumbar region, from the third to the fifth lumbar vertebræ inclusive, and pain in the right gluteal region.

This series of cases will illustrate more forcibly than any description of mine the ill effects and manifold evils that may result to the spine, the membranes, and the cord from sprains, wrenches, or twists of the vertebral column.

LECTURE VII.

ON THE MODE OF OCCURRENCE OF SHOCK, AND ON THE PATHOLOGY OF CONCUSSION OF THE SPINE.

PART I.

ON THE MODE OF OCCURRENCE OF SHOCK.

ONE of the most remarkable circumstances connected with injuries of the spine is, the disproportion that exists between the apparently trifling accident that the patient has sustained, and the

real and serious mischief that has in reality occurred, and which will eventually lead to the gravest consequence. Not only do symptoms of concussion of the spine of the most serious, progressive, and persistent character, often develop themselves after what are apparently slight injuries, but frequently when there is no sign whatever of external injury. This is well exemplified in Case 26, the patient having been partially paralysed simply by slipping down a few stairs on her heels. The shake or jar that is inflicted on the spine when a person jumping from a height of a few feet comes to the ground suddenly and heavily on his heels, or in a sitting posture, has been well known to surgeons as not an uncommon cause of spinal weakness and debility. It is the same in railway accidents; the shock to which the patient is subjected being followed by a train of slowly-progressive symptoms indicative of concussion and subsequent irritation and inflammation of the cord and its membranes.

It is not only true that the spinal cord may be indirectly injured in this way, and that sudden shocks applied to the body are liable to be followed by the train of evil consequences that we are now discussing, but I may even go farther, and say that these symptoms of spinal concussion seldom occur when a serious injury has been inflicted on one of the limbs, unless the spine itself has at the same time been severely and directly struck. A person who by any of the accidents of civil life meets with an injury by which one of the limbs is fractured or is dislocated, necessarily sustains a very severe shock, but it is a very rare thing indeed to find that the spinal cord or the brain has been injuriously influenced by this shock that has been impressed on the body. It would appear as if the violence of the shock expended itself in the production of the fracture or the dislocation, and that a jar of the more delicate nervous structures is thus avoided. I may give a familiar illustration of this from an injury to a watch by falling on the ground. A watchmaker once told me that if the glass was broken, the works were rarely damaged; if the glass escapes unbroken, the jar of the fall will usually be found to have stopped the movement.

How these jars, shakes, shocks, or concussions of the spinal cord directly influence its action I cannot say with certainty. We do not know how it is that when a magnet is struck a heavy blow with a hammer, the magnetic force is jarred, shaken, or concussed out of the horse-shoe. But we know that it is so, and that the iron has lost its magnetic power. So, if the spine is badly jarred, shaken, or concussed by a blow or shock of any kind communicated to the body, we find that the nervous force is to a certain extent shaken out of the man, and that he has in some way lost nerve-power. What immediate change, if any, has taken place in the nervous structure to occasion this effect, we no more know than what change happens to a magnet when struck. But we know that a change has taken place in the action of the nervous system just as we know that a change has taken place in the action of the iron by the loss of its magnetic force.

But whatever may be the nature of the primary change that is produced in the spinal cord by a concussion, the secondary effects are clearly of an inflammatory character, and are indistinguishable with those phenomena that have been described by Ollivier, Abercrombie, and others, as dependent on chronic meningitis of the cord, and sub-acute myelitis.

One of the most remarkable phenomena attendant upon this class of cases is, that at the time of the occurrence of the injury the sufferer is usually quite unconscious that any serious accident has happened to him. He feels that he has been violently jolted and shaken, he

is perhaps somewhat giddy and confused, but, he finds no bones broken, merely some superficial bruises or cuts on the head or legs, perhaps even no evidence whatever of external injury. He congratulates himself upon his escape from the imminent peril to which he has been exposed. He becomes unusually calm and self-possessed; assists his less-fortunate fellow-sufferers, occupies himself perhaps actively in this way for several hours, and then proceeds on his journey.

When he reaches his home, the effects of the injury sustained begin to manifest themselves. A revulsion of place. He bursts into tears, becomes unusually talkative and excited. He cannot sleep, or, if he does, he wakes with a vague sense of alarm. The next day he complains of being shaken or bruised all over, as if he had been beaten violently strained himself by exertion of an unusual kind. This soft and strained feeling chiefly affects the muscles of the neck and loins, sometimes extending to those of the shoulders and thighs. After a time, which varies much in different cases, from a day or two to a week or more, he finds that he is unfit for exertion and unable to attend to business. He now lays up, and perhaps for the first time seeks surgical assistance.

This is a general sketch of the early history of most of these cases of 'Concussion of the Spine' from railway accidents. The details necessarily vary much in different cases.

There is great variation in the period at which the more serious, persistent, and positive symptoms of spinal lesion begin to develop themselves. In some cases they do so immediately after the occurrence of the injury, in others not until several weeks, I might perhaps even say months, had elapsed. But during the whole of this interval, whether it be of short or of long duration, it will be observed that the sufferer's condition, mentally and bodily, has undergone a change. This is a point on which I would particularly insist. He never completely gets over the effects of the accident. There may be improvement; there is not recovery. There is a continuous chain of broken or ill health, between the time of the occurrence of the accident and the development of the more serious symptoms. It is this that enables the surgeon to connect the two in the relation of cause and effect. This is not peculiar to railway injuries, but it occurs in all cases of progressive paralysis after spinal concussion, and may be noted in the histories of many that have been given in these lectures. The friends remark, and the patient feels, that 'he is not the man he was.' He has lost bodily energy, mental capacity, business aptitude. He looks ill and worn; often becomes irritable and easily fatigued. He still believes that he has sustained no serious or permanent hurt, tries to return to his business, finds that he cannot apply himself to it, takes rest, seeks change of air and scene, undergoes medical treatment of various kinds, but finds all of no avail. His symptoms become progressively more and more confirmed, and at last he resigns himself to the conviction that he has sustained a more serious bodily injury than he had at first believed, and one that has, in some way or other, broken down his nervous power, and has wrought the change of converting a man of mental energy and of active business habits into a valetudinarian, a hypochondriac or a hysterical paralytic, utterly unable to attend to the ordinary duties of life.

The condition in which a patient will be at this or a later period of his sufferings, will be found detailed in several of the cases that have been related.

It may, however, throw additional light on this subject, if we analyse

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It may, however, throw additional light on this subject, if we analyse

the symptoms, and arrange them in the order in which they will present themselves on making a surgical examination of such a patient; bearing this important fact in mind, however, that although all and everyone of these symptoms may present themselves in any given case, yet that they are by no means all necessarily present in any one case. Indeed this usually happens, and we generally find that whilst some symptoms assume great prominence, others are proportionally dwarfed, or, indeed, completely absent. In these as in so many other cases, whether surgical or medical, it is well not to lay too much stress on the presence or absence of any one particular symptom, but we should take all the symptoms that present themselves in one group.

The *countenance* is usually pallid, lined, and has a peculiarly careworn, anxious expression; the patient generally looking much older than he really is or than he did before the accident. Occasionally there is flushing of the cheek and ear or of the forehead, accompanied by a sensation of great heat.

The *memory* is defective. This defect of memory shows itself in various ways; thus, Case 2 said that he could not recollect a message unless he wrote it down; Case 10 forgot some common words and misspelt others; Case 18 lost command over figures, he could not add up a few figures, and had also lost, in a great degree, the faculty of judging of weight, and of distance in a lateral direction; he forgot dates, the ages of his children, &c.

The *thoughts* are confused. The patient will sometimes, as in Case 28, break off in the middle of a sentence, unable to finish it; he cannot concentrate his ideas so as to carry on a connected line of argument; he attempts to read, but is obliged to lay aside the book or paper after a few minutes, not from weakness of sight, but from confusion of thought and inability to maintain a continuous mental strain.

All *business aptitude* is lost, partly as a consequence of impairment of memory, partly of confusion of thought and inability to concentrate ideas for a sufficient length of time. The will becomes enfeebled; the power of decision is lost; the mind becomes vacillating, and impotent of will.

The *temper* is often changed for the worse, the patient becoming fretful, irritable, and in some way—difficult perhaps to define, but easily appreciated by those around him—altered in character.

The *sleep* is disturbed, restless, and broken. He wakes up in sudden alarm; dreams much; the dreams are distressing and horrible.

The *head* is usually of its natural temperature, but sometimes hot. The patient complains of various uneasy sensations in it; of pain, tension, weight, or throbbing; of giddiness; or of a confused or constrained feeling. Frequently loud and incessant noises, described as roaring, rushing, ringing, singing, sawing, rumbling, or thundering are experienced. These noises vary in intensity at different periods of the day, but if once they occur, are never entirely absent, and are a source of great distress and disquietude to the patient.

The *organs of special sense* usually become more or less seriously affected. They may be over sensitive and irritable, blunted in their perceptions, or perverted in their sensations. In many cases we find a combination of all these conditions in the same organ.

Vision. The impairment of vision is so important in concussion of the spine that I shall devote a special lecture to it, to which I must refer you for details. It suffices now to give a brief sketch of the troubles connected with it in these cases of railway shock. In some cases, though rarely, there is double vision and perhaps slight strabismus. In others an alteration in the focal length, so that the patient

has to begin the use of glasses, or to change those he has previously worn. The patient suffers from asthenopia, he cannot read for more than a few minutes, the letters running into one another. More commonly, *muscæ volitantes* and spectra, rings, stars, flashes, sparks—white, coloured, or flame-like are complained of. The eyes often become over sensitive to light, so that the patient habitually sits in a shaded or darkened room, turns his back to the window, and cannot bear unshaded gas or lamplight. This intolerance of light may amount to positive photophobia. It gives rise to a habitually contracted state of the brows, so as to exclude light as much as possible from the eyes. One or both eyes may be thus affected. Sometimes one eye only is intolerant of light. This intolerance of light may be associated with dimness and imperfection of sight. Perhaps vision is normal in one eye, but impaired seriously in the other. The circulation at the back of the eye is visible to some patients, when they look up at a clear sky or on a white paper. Irregularity of the pupils is sometimes noticed, one being dilated, the other normal or contracted.

The *hearing* may be variously affected. Not only does the patient commonly complain of the noises in the head and ears that have already been described, but the ears, like the eyes, may be over sensitive or too dull. One ear is frequently over sensitive whilst the other is less acute than it was before the accident. The relative sensibility of the ears may readily be measured by the distance at which the tick of a watch may be heard. Loud and sudden noises are particularly distressing to these patients. The fall of a tray, the rattle of a carriage, the noise of children at play, are all sources of pain and of irritation. Deafness occasionally comes on in the course of the case; but it is not an early symptom. If the deafness is owing to injury inflicted on the auditory nerve or on the brain, the patient will not be able to hear on the affected side the vibrations of a tuning fork when the instrument is applied to the forehead. But if the defect be dependent on obstructive disease or of injury of the external or middle ear, the nervous apparatus being perfect, the vibrations transmitted throughout the bones of the skull will not only be audible in the affected ear, but being retained there, and prevented passing outwards, are actually heard more loudly in it than in the sound one.

Taste and smell are much less frequently affected than sight or hearing; but they may be perverted or lost. The sense of smell is more frequently affected than that of taste. It may be perverted so that the patient thinks he is always smelling a fetid odour. It is always disagreeably, never pleasantly perverted. When once lost, it is never recovered. I have never known the sense of taste to be lost; that is to say, I have never known a patient who could not distinguish between salt and sugar; but owing to the frequent impairment or loss of the sense of smell, the perception or taste of flavours is often lost, in the perception of which the sense of smell plays as important a part as that of taste.

The *sense of touch* is impaired. The patient cannot pick up a pin, cannot button his dress, cannot feel the difference between different textures, as cloth and velvet. He loses the sense of *weight*, cannot tell whether a sovereign or a shilling is balanced on his finger.

Speech is rarely affected. Case 29 stammered somewhat before the accident, but after it his speech became a most painful and indescribably confused stutter that it was almost impossible to comprehend. The same phenomenon was observed in the Count de Lordat's case, p. 5. But it is certainly rare.

The *attitude* of these patients is usually peculiar. It is stiff and un-

bending. They hold themselves very erect, usually walk straight forwards, as if afraid or unable to turn to either side. The movements of the head or trunk, or both, do not possess their natural freedom. There may be pain or difficulty in moving the head in the antero-posterior direction, or in rotating it, or all movements may be attended by so much pain and difficulty that the patient is afraid to attempt them, and hence he keeps the head in its attitude of immobility.

The movements of the trunk are often equally restrained, especially in the lumbar region. Bending forwards, backwards, or sideways, is painful, difficult, and may be impossible; bending backwards is usually most complained of.

If the patient is asked to stoop and pick up anything off the ground, he will not be able to do so in the usual way, but goes down on the knee and so reaches the ground.

If he is laid horizontally and told to raise himself up without the use of his hands, he will be unable to do so.

The *state of the spine* will be found to be the real cause of all these symptoms.

On examining it by pressure, by percussion, or by the application of the hot sponge, it will be found that it is painful, and that its sensibility is exalted at one, two, or three points. These are usually in the upper or lower cervical, the middle dorsal, and the lumbar regions. The vertebræ that are affected vary necessarily in different cases, but the exalted sensibility always includes two, and usually three, at each of these points. It is on account of the pain occasioned by any movement of the trunk by way of flexion or rotation, that the spine loses its natural suppleness, and that the vertebral column moves as a whole, as if cut out of one solid piece, instead of with the flexibility that its various component parts naturally gives to all its movements.

The movements of the head upon the upper cervical vertebræ are variously affected. In some cases the head moves freely in all directions, without pain or stiffness, these conditions existing in the lower and middle, rather than in the upper cervical vertebræ. In other cases, again, the greatest agony is induced if the surgeon takes the head between his hands and bends it forwards or rotates it, the articulations between the occipital bone, the atlas, and the axis being evidently in a state of inflammatory irritation. This happened in a very marked manner in Cases 18 and 19; and in both these it is interesting to observe that distinct evidences of cerebral irritation had been superadded to those of the more ordinary spinal mischief.

The pain is usually confined to the vertebral column, and does not extend beyond the transverse processes. But in some instances, as in Case 2, the pain extended widely over the back on both sides, more on the left than on the right, and seemed to correspond with the distribution of the posterior branches of the dorsal nerves. In these cases, owing to the musculo-cutaneous distribution of these nerves, the pain is superficial and cutaneous as well as deeply-seated in the spine.

The muscles of the back are usually unaffected, but in some cases where the muscular branches of the dorsal nerves are affected, as in Case 19, they may be found to be very irritable and spasmodically contracted, so that their outlines are very distinct and marked.

The *gait* of the patient is remarkable and characteristic. He walks more or less unsteadily, very like a person who is partially inebriated, or like one suffering from locomotor ataxy; generally he uses a stick, or if deprived of that, he is apt to lay his hand on any article of furniture that is near him, with the view of steadying himself.

He keeps his feet somewhat apart, so as to increase the basis of support, and consequently walks in a straddling manner.

One leg is often weaker than the other, the left more frequently than the right. Hence he totters somewhat, raises the weak foot but slightly off the ground, so that the heel is apt to touch. He often drags the toe, or, walking flat-footed, drags the heel. This peculiar straddling, tottering, unsteady gait, with the rigid spine, the erect head, while the patient looks straight forward, gives him the aspect of a man who walks blindfolded.

The patient cannot generally stand equally well on either foot. One leg, usually the left, immediately gives way under him if he attempts to stand on it.

He often cannot raise himself on his toes, or stand on them, without immediately tottering forwards.

His power of walking is always very limited; it seldom exceeds half a mile or a mile at the utmost.

He cannot ride, even if much in the habit of doing so before the accident. He loses both grip and balance.

There is usually considerable difficulty in going up and down stairs—more difficulty in going down than up. The patient is obliged to support himself by holding on to the balusters, and often brings both feet together on the same step.

A sensation as of a cord tied round the waist, with occasional spasm of the diaphragm, giving rise to a catch in the breathing, or hiccup, is sometimes met with, and is very distressing when it does occur.

The *motor power and sensation* will be found to be variously modified, and will generally be so to very different degrees in the different limbs. I have fully described the various modifications of motion and sensation in cases of direct spinal injury in lecture II, and would refer to this account, which will be found closely to resemble the phenomena that result from nervous shock in railway collisions. Sometimes one limb only is affected, at others the arm and leg on one side, or both legs only, or the arm and both legs, or all four limbs, are the seat of uneasy sensations. There is the greatest possible variety in these respects, dependent of course entirely upon the degree and extent of the lesion that has been inflicted upon or induced in the spinal cord.

Sensation only may be affected, or it may be normal, and motion may be impaired; or both may be affected to an equal, or one to a greater and the other to a less, degree. And these conditions may happen in one or more limbs. Thus sensation and motion may be seriously impaired in one limb, or sensation in one and motion in another. The paralysis is seldom complete. It may become so in the more advanced stages after a lapse of several years, but for the first year or two it is (except in cases of direct and severe violence) almost always partial. It is sometimes incompletely recovered from, especially so far as sensation is concerned.

The *loss of motor power* is usually greater, and, as a rule, is always more apparent than that of sensation. In many cases sensation undoubtedly continues perfect, whilst the motor power is seriously impaired. In other cases, again, motion appears to be more seriously affected than sensation, simply because it is so much easier to test and to appreciate the full extent of the loss of motor than of sensory power.

The *loss of motor power* is especially marked in the legs, and more in the extensor than in the flexor muscles. The extensor of the great toe is especially apt to suffer. The hand and arm are less frequently the seats of loss of motor power than the leg and foot; but the muscle of the ball of the thumb, or the flexors of the fingers, may be so affected.

It will be found that these symptoms of paraplegia are much more marked when the patient stands up than when he lies down. In this respect, indeed, the form of partial paralysis that we are now considering resembles those forms of the disease that arise from other causes than injury. A patient who can scarcely stand, and who walks with a feeble, tottering, jerking gait, will, when he lies down, readily move his limbs in any direction, and exercise a considerable amount of power either in flexion or extension. Whether this is due, as Matthew Baillie supposed, to the increased pressure of the cord by the spinal fluid, or to the greater venous congestion of the lower portion whilst the patient is standing than when he is lying down, may be matter of speculation, but the fact is certain that in all cases of incipient and partial paraplegia, the symptoms are most marked when the patient stands, and subside to a great extent when he lies down.

The loss of motor power in the foot and leg is best tested by the application of the galvanic current, so as to compare the irritability of the same muscles of the opposite limbs. The value of the electric test is, that it is not under the influence of the patient's will, and that a very true estimate can thus be made of the loss of contractility in any given set of muscles.

The loss of motor power in the hand is best tested by the force of the patient's grasp. This may be roughly estimated by telling him to squeeze the surgeon's fingers, first with one hand and then the other, or more accurately by means of the dynamometer, which shows on the index the precise amount of pressure that a person exercises in grasping.

It is in consequence of the diminution of motor power in the legs that those peculiarities of gait which have just been described are met with, and they are most marked when the amount of loss is unequal in the two limbs, as the paraplegia is partial. The sphincters are very rarely affected in the cases now under consideration. Sometimes there is increased frequency of micturition, but I have rarely met with retention of urine or with cases requiring the continued use of the catheter; nor have I observed in any case that the contractility of the sphincter ani had been so far impaired as to lead to involuntary escape of flatus or feces.

Modification or diminution of sensation in the limbs is one of the most marked phenomena in these cases.

In many instances the sensibility is a good deal augmented, especially in the earlier stages. The patient complains of shooting pains down the limbs, like stabs, darts, or electrical shocks. The surface of the skin is sometimes over-sensitive in places in the back (as in Case 19), or in various parts of the limbs, hot, burning sensations are experienced in it. After a time these sensations give place to various others, which are very differently described by patients. Tinglings, a feeling of 'pins and needles,' a heavy sensation, as if the limb was asleep, creeping sensations down the back and along the nerves, and formications, are all commonly complained of. These sensations are often confined to one nerve in a limb, as the ulnar for instance, or the musculo-spiral.

The existence of numbness does not necessarily imply the loss of the sense of touch. The fingers may feel 'numb' and yet be well able to detect the difference between hard and smooth, soft and rough, moist and dry things.

Numbness, more or less complete, may exist independently of, or be associated with, all these various modifications of sensation, with pain, tingling, or creeping sensations. Its extent will vary greatly; it may be confined to a part of a limb, may influence the whole of it, or may

extend to two, three, or even to the four limbs; its degree and extent are best tested by Brown-Séguard's æsthesiometer.

Coldness of one of the extremities dependent upon actual loss of nervous power, and defective nutrition, is often perceptible to the touch, and may be accurately determined by the clinical thermometer; but in many cases it is found that the sensation of coldness is far greater to the patient than it is to the surgeon's hand, and not unfrequently no appreciable difference in the temperature of two limbs can be determined by the most delicate clinical thermometer, although the patient experiences a very distinct and distressing sense of coldness in one of the limbs.

The condition of the limbs as to size, and the state of their muscles, will vary greatly.

In some cases of complete paraplegia, which has lasted for years, as in Case 4, it has been remarked that no diminution whatever had taken place in the size of the limbs. This was also the case in Case 2, where the paralysis was partial. It is evident, therefore, that loss of size in a limb which is more or less completely paralysed is not the simple consequence of the disuse of the muscles, or it would always occur. But it must arise from some modification of innervation, influencing the nutrition of the limb, independently of the loss of muscular activity.

In most cases, however, where the paralytic condition has been of some duration, the size of the limb dwindles; and on accurate measurement it will be found to be somewhat smaller in circumference than its fellow on the opposite side.

The state of the muscles as to firmness will also vary. Most commonly when a limb dwindles the muscles become soft, and the inter-muscular spaces more distinct. Occasionally in advanced cases a certain degree of contraction and of rigidity in particular muscles sets in. Thus the flexors of the little and ring fingers, the extensors of the great toe, the deltoid or the muscles of the calf, may all become the seats of more or less rigidity and contraction.

The electric irritability of the muscles of the partially paralysed limb is much lessened, sometimes destroyed, in certain groups of muscles, whilst it continues more or less perfect in others.

The body itself generally loses weight; and a loss of weight, when the patient is deprived of all exercise, and is rendered inactive by a semi-paralysed state, and takes a fair quantity of good food, which he digests sufficiently well, is undoubtedly a very important and a very serious sign, and may usually be taken to be indicative of progressive disease in the nervous system.

When the progress of the disease has been arrested, though the patient may be permanently paralysed, we often see a considerable increase of size and weight take place. As nerve action becomes enfeebled, the grosser corporeal elements attain preponderance—adipose matter is deposited. This is a phenomenon of such common occurrence in ordinary cases of paralysis from disease of the brain, that I need do no more than mention that it is also of not unfrequent occurrence in those forms that proceed from injury, whether of the cord or brain.

The condition of the Genito-Urinary organs is seldom much deranged in the cases under consideration, as there is usually no paralysis of the sphincters. Neither retention of urine nor incontinence of flatus and fæces occurs. Sometimes, however, irritability of the bladder is a prominent symptom. The urine generally retains its acidity, sometimes markedly, at others but very slightly so. As there is no retention, it does not become alkaline, ammoniacal, or otherwise offensive.

Priapism does not occur in these cases as in meningeal irritation, or in fractures with laceration of, or pressure on, the cord.

The *sexual desire and power* are usually greatly impaired, and often entirely and permanently lost. Not invariably so, however. The wife of Case 18 miscarried twice during the twelvemonth succeeding her husband's accident.

The *pulse* varies in frequency at different periods. In the early stages it is usually slow. In the more advanced it is quick, near to or above 100. In one case I found it unequal at the two wrists. It is always feeble, and sometimes irregular or intermitting. The skin is usually cold and clammy.

The order of the progressive development of the various symptoms that have just been detailed is a matter of great interest in these cases. As a rule, each separate symptom comes on very gradually and insidiously. It usually extends over a lengthened period.

In the early stages, the chief complaint is a sensation of lassitude, weariness, and inability for mental and physical exertion. Then come the pains, tinglings, and numbness of the limbs; next the fixed pain and rigidity of the spine; then the mental confusion, and signs of cerebral disturbance, and the affection of the organs of the sense; the loss of motor power, and the peculiarity of gait.

The period of the supervention of these symptoms after the occurrence of the injury will greatly vary. In cases of severe and direct concussion of the spine, the symptoms are usually immediate and distinctly marked. In the cases of general nervous shock, and of slight and indirect concussion of the cord, no immediate effects are produced, or if they are, they are transitory, and commonly after the first and immediate effects of the accident have passed off there is a period of comparative ease, and of remission of the symptoms, but not of recovery, during which the patient imagines that he will speedily regain his health and strength. This period may last for many weeks, possibly for two or three months. At this time there will be considerable fluctuation in the patient's condition. So long as he is at rest, he will feel tolerably well; but any attempt at ordinary exertion of body or mind brings back all the feelings and indications of nervous prostration and irritation so characteristic of these injuries; and to these will gradually be superadded those more serious symptoms that have already been fully detailed, which evidently proceed from a chronic disease of the cord and its membranes. After a lapse of several months—from three to six—the patient will find that he is slowly but steadily becoming worse, and he then, perhaps for the first time, becomes aware of the serious and deep-seated injury that his nervous system has sustained.

Although there is often this long interval between the time of the occurrence of the accident and the supervention of the more distressing symptoms, and the conviction of the serious nature of the injury that has been sustained, it will be found, on close enquiry, *that there has never been an interval, however short, of complete restoration to health.* There have been remissions, but no complete and perfect intermission in the symptoms. The patient has thought himself and has felt himself much better at one period than he was at another, so much so that he has been tempted to try to return to his usual occupation, but he has never felt himself well, and has immediately relapsed to a worse state than before when he has attempted to do work of any kind.

It is by this chain of symptoms, which, though fluctuating in intensity, is yet continuous and unbroken, that the injury sustained, and the illness subsequently developed, can be linked together in the relation of cause and effect.

PART II.

ON THE PATHOLOGY OF CONCUSSION OF THE SPINE.

Having thus described the various symptoms that may arise from these shocks to and concussions of the spine, let us now briefly enquire into the pathological conditions that lead to and that are the direct causes of these phenomena.

I have pointed out and discussed at some length the pathological conditions that are found within the spinal canal in those cases of more or less complete paralysis that result from direct and violent blows upon the back without fracture or dislocation of the bones entering into the formation of the vertebral column. We have seen that in these cases the signs of spinal lesion are referable to extravasation of blood in various parts within the spinal canal, to rupture of the membranes of the cord, to inflammatory effusions, or to softening and disorganisation of the cord itself.

In those cases in which the shock to the system has been general and unconnected with any local and direct implication of the spinal column by external violence, and in which the symptoms, as just detailed, are less those of paralysis than of disordered nervous action, the pathological states on which these symptoms are dependent are of a more chronic and less directly obvious character than those above mentioned.

We should indeed be taking a very limited view of the Pathology of Concussion of the Spine if we were to refer all the symptoms, primary and remote, to inflammatory conditions, either of the vertebral column, the sheaths of the spinal nerves, the meninges of the cord, or the substance of the medulla itself. Important and marked as may be the symptoms that are referable to such lesions as these, there are undoubtedly states, both local and constitutional, that are primarily dependent on molecular changes in the cord itself, or on spinal anæmia induced by the shock of the accident acting either directly on the cord itself, or indirectly, and at a later date, through the medium of the sympathetic, in consequence of which the blood distribution to the cord becomes disturbed and diminished.

In spinal concussion there would indeed appear to be two distinct and indeed widely opposed conditions induced, viz. spinal anæmia and spinal inflammation. It is of great importance to bear in mind that these two conditions—entirely distinct, and indeed opposed as they are pathologically—may yet give rise to many symptoms that have much in common. There is, however, this wide difference between them, that 'anæmia of the cord' is rather a functional disease—a clinical expression possibly, more than a well-proved pathological fact—whilst, on the other hand, the intra-spinal inflammations, whether they affect the membranes of the cord—the cord itself or both—are well recognised and easily determinable pathological states, the conditions connected with which are positive organic lesions that lie at the bottom of the functional disturbance. There is then this essential difference between the two affections, that whereas the sign of functional disturbance may be much the same in both, in one it is underlaid by organic disease and structural change, in the other by no appreciable pathological condition.

We will first consider the pathology of the inflammatory states of the cord or its membranes that may proceed from concussion of the spine,

and then consider that condition of so-called spinal anæmia that may result from 'nervous shock.' They doubtless consist mainly of chronic and sub-acute inflammation of the spinal membranes, and in chronic myelitis, with such changes in the structure of the cord as are the inevitable consequences of a long-continued chronic inflammatory condition developed by it.

It would at first sight appear a somewhat remarkable circumstance, that notwithstanding the frequency of the occurrence of cases of concussion of the spine in railway and other accidents, there should be so few instances on record of examinations of the cord after death in these cases. But this feeling of surprise will be lessened when we reflect on the general history of these cases. If in these, as in cases of direct injury of the spine with fracture or dislocation, the effects were immediate, severe, and often speedily fatal, surgical literature would abound with the details of the *post-mortem* appearances presented by them, as it does with those of the more direct injuries just alluded to. But as in these cases of spinal concussion the symptoms are remarkably slow in their development and chronic in their progress—as the patient will live for years in a semi-paralysed state during which time the original cause of his sufferings has almost been forgotten—as he seldom becomes the inmate of a hospital—for the chronic and incurable nature of his ailments does not render him so much an object for such a charity as for some asylum or for private benevolence—and as the cause of his death does not become the subject of investigation before a coroner's court, there is little opportunity, reason, or excuse for a *post-mortem* investigation of that structure, which is probably the one that is least frequently examined in the dead-house, viz. the spinal cord, as it is the one the correct pathological investigation of which is attended by more difficulties than that of any other organ in the body. Hence it is that as in most other chronic nervous diseases that are only remotely fatal—as in cases of hysteria, neuralgia, and in nine-tenths of those of epilepsy, we have no opportunity of determining in cases of concussion of the spine very remotely fatal, what the anatomy of the parts concerned would reveal of the real cause of the obscure and intricate symptoms presented during life. So rare are *post-mortem* examinations of these cases that no instance has occurred to me in hospital or in private practice in which I could obtain one; and, with one exception, I can find no record in the transactions of societies or in the periodical literature of the day of any such instance.

The only case indeed on record with which I am acquainted, in which a *post-mortem* examination has been made of the spinal cord of a person who had actually died from the remote effects of concussion of the spine from a railway collision, is one that was published in the 'Transactions of the Pathological Society' by Dr. Lockhart Clarke. The patient, who had been under the care of Mr. Gore, of Bath, by whom the preparation was furnished, was a middle-aged man, 52 at the time of death, of active business habits. He had been in a railway collision, and, without any sign of external injury, fracture, dislocation, wound, or bruise, began to manifest the usual nervous symptoms. He very gradually became partially paralysed in the lower extremities, and died three years and a half after the accident.

Mr. Gore has most kindly furnished me with the following particulars of the case. Immediately after the collision the patient walked from the train to the station close at hand. He had received no external sign of injury—no contusions or wounds, but he complained of a pain in his back. Being most unwilling to give in, he made every effort to get about in his business, and did so for a short time after the accident, though

with much distress. Numbness and a want of power in the muscles of the lower limbs gradually but steadily increasing, he soon became disabled. His gait became unsteady, like that of a half-intoxicated person. There was great sensitiveness to external impressions, so that a shock against a table or chair caused great distress. As the patient was not under Mr. Gore's care from the first, and as he only saw the case for the first time about a year after the accident, and then at intervals up to the time of death, he has not been able to inform me of the precise time when the paralytic symptoms appeared; but he says that this was certainly within less than a year of the time of the occurrence of the accident. In the latter part of his illness some weakness of the upper extremities became apparent, so that if the patient was off his guard a cup or a glass would slip from his fingers. He could barely walk with the aid of two sticks, and at last was confined to his bed. His voice became thick and his articulation imperfect. There was no paralysis of the sphincter of the bladder until about eighteen months before his death, when the urine became pale and alkaline, with muco-purulent deposits. In this case the symptoms were in some respects not so severe as usual, there was no very marked tenderness or rigidity of the spine, nor were there any convulsive movements.

The cord was carefully examined by Dr. Lockhart Clarke, by whom the case has been published.¹

On examination, traces of chronic inflammation were found in the arachnoid and the cortical substance of the brain. The spinal meninges were greatly congested, and exudative matter had been deposited upon the surface of the cord. The cord itself was much narrowed in its antero-posterior diameter, so that in many places this was not more than half of the transverse diameter. This was particularly the case in the cervico-dorsal region. The narrowing was owing to absorption of the posterior columns, which, of all the white columns, were exclusively the seat of disease. These had not only to a great extent disappeared, but the remains were of a dark-brownish color, and had undergone important structural changes. This case is of remarkable interest and practical value, as affording evidence of the changes that take place in the cord under the influence of 'concussion of the spine' from a railway accident. Evidences of chronic meningitis—cerebral as well as spinal—of chronic myelitis, with subsequent atrophy, and other organic changes dependent on mal-nutrition of the affected portion of the cord being manifest.²

¹ *Transactions of the Pathological Society of London*, 1866, vol. xvii. p. 21.

² The detailed report of the examination made by Dr. Lockhart Clarke is so valuable that I give it in full:—

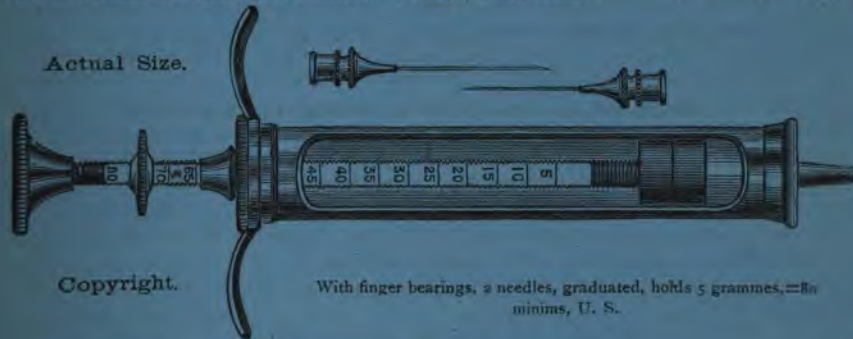
On examining the spinal cord, as it was sent to me by Mr. Gore, I found that the membranes at some parts were thickened, and adherent at others, to the surface of the white columns. In the cord itself, one of the most striking changes consisted in a diminution of the antero-posterior diameter, which, in many places, was not more than equal to half the transverse. This was particularly the case in the upper portion of the cervical enlargement, where the cord was consequently much flattened from behind forward. On making sections, I was surprised to find that of all the *white* columns, the *posterior* were exclusively the seat of disease. These columns were darker, browner, denser, and more opaque than the antero-lateral; and when they were examined, both transversely and longitudinally, in their preparations under the microscope, this appearance was found to be due to a multitude of compound granular corpuscles, and isolated granules, and to an exuberance of wavy fibrous-tissue disposed in a longitudinal direction. It was very evident that many of the nerve-fibres had been replaced by this tissue, and that at certain spots or tracts, which were more transparent than others, especially along the sides of the posterior median fissures, they had wholly disappeared. Corpora amylacea, also, were thickly interspersed through the same columns, particularly near the central line.

The extremities of the posterior horns contained an abundance of isolated

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It is well known that two distinct forms of chronic or sub-acute inflammation may affect the contents of the spinal canal as the results of injury or of idiopathic disease, viz. inflammation of the membranes, and inflammation of the cord itself.

In spinal meningitis the usual signs of inflammatory action in the form of vascularisation of the membranes is met with. The meningo-rachidian veins are turgid with blood, and the vessels of the pia-mater are found much injected, sometimes in patches, at others uniformly so. Serous fluid, reddened, and clear, or opaque from the admixture of lymph, may be found largely effused in the cavity of the arachnoid.

Ollivier¹ states that one of the most constant signs of chronic spinal meningitis is adhesion between the serous lamina that invests the dura-mater and that which corresponds to the spinal pia-mater. This he says he has often observed, and especially in that form of the disease which is developed as the result of a lesion of the vertebræ. He has also seen rough cartilaginous (fibroid?) laminæ developed in the arachnoid. Lymph also of a puriform appearance has often been found under the arachnoid, between it and the pia-mater.

In distinguishing the various pathological appearances presented by fatal cases of chronic spinal meningitis, Ollivier makes the very important practical remark—the truth of which is fully carried out by a consideration of the cases related in Lectures II. and III.—that spinal meningitis rarely exists without there being at the same time a more or less extensive inflammation of the cerebral meninges; and hence, he says, arises the difficulty of determining with precision the symptoms that are special to inflammation of the membranes of the spinal cord.

When myelitis occurs, the inflammation attacking the substance of the cord itself, the most usual pathological condition met with is softening of its substance, with more or less disorganisation of its tissue. This softening of the cord as a consequence of its inflammation may, according to Ollivier, occupy very varying extent of its tissue. Sometimes the whole thickness of the cord is affected at one point, sometimes one of the lateral halves in a vertical direction is affected; at other times it is most marked in or wholly confined to its anterior or its posterior aspect, or the grey central portion may be more affected than the circumferential part. Then, again, these changes of structure may be limited to one part only—to the cervical, the dorsal, or the lumbar. It is very rare indeed that the whole length of the cord is affected. The most common seat of the inflammatory softening is the lumbar region; next in order of frequency the cervical. In very chronic cases of myelitis, the whole of the nervous substance disappears, and nothing but connective tissue is left behind at the part affected.

Ollivier makes the important observation, that when myelitis is consecutive to meningitis of the cord, the inflammatory softening may be confined to the white substance.

But though softening is the ordinary change that takes place in a cord that has been the seat of chronic inflammation, yet sometimes the nervous substance becomes indurated, increased in bulk, more solid than natural, and of a dull white colour, like boiled white of egg. This induration of the cord may coexist with spinal meningitis, with

granules like those in the columns; and in some sections the transverse commissure was somewhat damaged by disintegration. The anterior cornua were decidedly smaller than natural, and altered in shape, but no change in structure was observed.¹

Dr. Clarke observes that the appearances presented by the cord bore a striking resemblance in the limitations of the lesion to the white substance to what is met with in Locomotor Ataxy.

¹ Vol. ii. p. 237.

congestion, and increased vascularisation of the membranes. The case of the Count de Lord at (p. 5) is an instance of this induration and enlargement of the substance of the cord, and others of a similar nature are recorded by Portal, Ollivier, and Abercrombie.

It is important to observe, that although spinal meningitis and myelitis are occasionally met with distinct and separate from each other, yet that they most frequently co-exist. When existing together, and even arising from the same cause, they may be associated with each other in very varying degrees. In some cases the symptoms of meningitis, others those of myelitis, are most marked, and after death the characteristic appearances present a predominance corresponding to that assumed by their effects during life.

I have given but a very brief sketch of the pathological appearances that are usually met with in spinal meningitis and in myelitis, as it is not my intention in these Lectures to occupy your attention with an elaborate enquiry into the pathology of these affections, but rather to consider them in their clinical relations.

I wish now to direct your attention to the symptoms that are admitted by all writers on diseases of the nervous system to be connected with and dependent upon the pathological conditions that I have just detailed to you, and to direct your attention to a comparison between these symptoms and those that are described in the various cases that I have detailed to you as characteristic of 'Concussion of the Spine' from slight injuries and general shocks of the body.

The symptoms that I have detailed at pp. 73 to 82, arrange themselves in three groups :—

- 1st. The cerebral symptoms.
- 2nd. The spinal symptoms.
- 3rd. Those referable to the limbs.

In comparing the symptoms of 'Concussion of the Spine' arising from railway and other accidents, as detailed in the cases I have related, with those that are given to and accepted by the Profession as dependent on spinal meningitis and myelitis arising from other causes, I shall confine the comparison of my cases to those related by Abercrombie and Ollivier. And I do this for two reasons; first, because the works of these writers on diseases of the spinal cord are universally received as the most graphic and classical on the subject of which they treat in this country and in France; and, secondly, because their descriptions were given to the world before the railway era, and consequently could in no way have been influenced by accidents occurring as a consequence of modern modes of locomotion.

1. With respect to the cerebral symptoms. It will be observed that in most of the cases that I have related, there was more or less cerebral disturbance or irritation, as indicated by headache, confusion of thought, loss of memory, disturbance of the organs of sense, irritability of the eyes and ears, &c.:—symptoms, in fact, referable to subacute cerebral meningitis and arachnitis.

On this point the statement of Ollivier is most precise and positive. He says that it is rare to find inflammation of the spinal membranes limited to the vertebral canal, but that we see at the same time a more or less intense cerebral meningitis. In the cases that he relates of spinal meningitis, he makes frequent reference to these cerebral symptoms—states that they often complicate the case so as to render the diagnosis difficult, especially in the early stages. In the *post-mortem* appearances that he details of patients who have died of spinal meningitis, he describes the morbid conditions met with in the cranium, indicative of

increased vascularity and inflammation of the arachnoid. This complication of cerebral with spinal meningitis is nothing more than we should expect. It may arise from two causes:—Either from the head having been injured at the same time and in the same way as the spine, or as a simple consequence of inflammation running along a continuous membrane. In both the fatal cases of meningitis of the spine recorded by Abercrombie, evidences of intra-cranial mischief are described.

2. The spinal symptoms that occurred in the cases of 'Concussion of the Spine' which I have related, consisted briefly of pain at one or more points of the spine, greatly increased on pressure, and on movement of any kind, so as to occasion extreme rigidity of the vertebral column.

Ollivier says that one of the most characteristic signs of spinal meningitis is pain in the spine, which is most intense opposite the seat of inflammation. This pain is greatly increased by movement of any kind, so that the patient, fearing the slightest displacement of the spine, preserves it in an absolute state of quiescence. This pain is usually accompanied by muscular rigidity. It remits, being sometimes much more severe than at others, and occasionally it even disappears entirely. According to some observers, the pain of spinal meningitis is increased by pressure. But the correctness of this observation is doubted by Ollivier, who says that in chronic myelitis there is a painful spot in the spine where the pain is increased on pressure, and he looks upon this as indicative of inflammation of the cord rather than of the membranes.

3. The third group of symptoms dependent on concussion of the spine are those referable to the limbs. They have been described at pp. 77, 80, and may briefly be stated to consist in painful sensations along the course of the nerves, followed by more or less numbness, tingling, and creeping; some loss of motor power affecting one or more of the limbs, and giving rise to peculiarity and unsteadiness of gait. No paralysis of the sphincters.

These are the very symptoms that are given by Ollivier and others as characteristic of spinal meningitis, but more particularly of myelitis.

In spinal meningitis, says Ollivier, there is increased sensibility in different parts of the limbs, extending along the course of the nerves, and augmented by the most superficial pressure. These pains are often at first mistaken for rheumatism. There is often also more or less rigidity and contraction of the muscles.

In myelitis the sensibility is at first augmented, but after a time becomes lessened, and gives way to various uneasy sensations in the limbs, such as formications, a feeling as if the limb was asleep (*engourdissement*). These sensations are first experienced in the fingers and toes, and thence extend upwards along the limbs.

These sensations are most complained of in the morning soon after leaving bed. They intermit at times, fluctuating in intensity, and in the early stages are lessened after exercise, when the patient feels better and stronger for a time, but these attempts are followed by an aggravation of the symptoms. Some degree of paralysis of movement, of loss of motor power, occurs in certain sets of muscles—or in one limb. Thus the lower limbs may be singly or successively affected before the upper extremities, or *vice versa*. Occasionally this loss of power assumes a hemiplegic form. All this will vary according to the seat and the extent of the myelitis.

There is usually constipation in consequence of loss of power in the lower bowel. It is very rare that the bladder is early affected, the patient having voluntary control over that organ until the most advanced stages of the disease, towards the close of life, when the softening of the cord is complete.

Ollivier remarks, that in chronic myelitis patients often complain of a sensation as of a cord tied tightly round the body.

The gait (*démarche*) of patients affected with chronic myelitis is peculiar. It is unsteady, rolling, like that of a partially intoxicated man. The foot is raised with difficulty, the toes are sometimes depressed and at others they are raised, and the heel drags in walking. The body is kept erect and carried somewhat backwards.

If we take any one symptom that enters into the composition of these various groups, we shall find that it is more or less common to various forms of disease of the nervous system. But if we compare the groups of symptoms that have just been detailed, their progressive development and indefinite continuance, with those which are described by Ollivier and other writers of acknowledged authority on diseases of the nervous system, as characteristic of spinal meningitis and myelitis, we shall find that they mostly correspond with one another in every particular—so closely, indeed, as to leave no doubt that the whole train of nervous phenomena arising from shakes and jars of or blows on the body, and described at pp. 73 to 82 as characteristic of so-called ‘Concussion of the Spine,’ are in reality due to chronic inflammation of the spinal membranes and cord. The variation in different cases being referable partly to whether meningitis or myelitis predominates, and in a great measure to the exact situation and extent of the intra-spinal inflammation, and to the degree to which its resulting structural changes may have developed themselves in the membranes or cord.

We will now proceed briefly to consider the second pathological state to which the symptoms of many of these cases of Concussion of the Spine from indirect and often slight injuries may be referred—I mean that state which is now recognised as Spinal Anæmia. And especially the so-called ‘Anæmia of the Posterior Columns of the Cord.’

As has already been stated, this is a condition which we rather recognise clinically than pathologically, by analogy than by direct *post-mortem* demonstration, by therapeutical rather than by physiological tests. But yet it is a condition that is now fully recognised as probable, in lieu of positive evidence, by the best and most modern writers on nervous diseases, and one the probable existence of which we may accept.

I have given you the views of Ollivier and Abercrombie on the true pathological state of myelitis and meningitis. Let me refer you to those of the most recent writer on nervous diseases, Hammond, of New York, on the subject of Spinal Anæmia.¹ In his work you will find a very complete and exhaustive account of the idiopathic forms of it which in many respects closely resemble the traumatic which we are now considering.

The Functional Paralysis or Paresis met with in Spinal Anæmia is a very common sequence of Spinal Concussion. It chiefly affects the lower extremities—one or both—but may be hemiplegic. There is complete anæsthesia involving large tracts of the surface of the limbs and body, usually without reference to any distinct nerves or to their anatomical distributions. The skin is cold and pallid. Motor power may be completely lost, or it may be diminished or even absent in one group of muscles and not in another. There is diminution or even complete loss of electric irritability in the affected muscles. In this condition there are usually some of the more general symptoms of hysteria; notably the ‘globus’ or the emotional state. There is also very commonly either incontinence or retention of urine. I have known no urine passed for three or four days in such cases,

¹ *On Diseases of the Nervous System*, by Dr. Hammond, New York, 1873.

and yet on introducing a catheter the bladder has been found to contain only perhaps 20 to 24 ounces—a proof that the secretion of the kidneys is arrested as well as the expulsive power of the bladder lost.

In this Paresis there is no atrophy or rigidity of muscles; the limbs, though cold, motionless, and more or less devoid of sensation, do not waste; and however long the patient lies in bed no bed-sore forms. Recovery eventually occurs; often very rapidly, and possibly under the influence of some mental emotion—by the grief of a death, by the necessity for exertion. By these various signs may Paresis or functional, be diagnosed from true or organic, Paralysis.

LECTURE VIII.

ON SPINAL ANÆMIA, HYSTERIA, SHOCK AND UNCONSCIOUSNESS AS CONSEQUENCES OF CONCUSSION OF THE SPINE.

ANÆMIA of the spinal cord is that condition which has long been recognized by physicians in one of its forms as giving rise to a group of symptoms which collectively are known familiarly as constituting the disease called "Spinal Irritability." Most commonly the disease stops here, but there is another form in which it advances beyond the stage of irritation and enters that of paralysis. The symptoms of this condition are those of exhaustion, associated, as all conditions of nervous exhaustion are apt to be, with neuralgic pains or hyperæsthesia, which often assumes such prominence as to overshadow the allied conditions of a paralytic character. These symptoms may develop themselves suddenly after the receipt of an injury of the spine, more especially in persons who by a previous state of weak or ill health are predisposed to their occurrence, or they may occur more gradually in those whose health is broken down, whose nutrition is impaired, and who consequently become anæmic as the result of disturbance of the system induced by the injury to which they have been subjected. It is a condition that is most apt to occur in the young, more especially in women, under the age of 35. I have, however, seen many unequivocal instances of this condition in men, and in individuals of both sexes, several years older than this.

The symptoms of spinal anæmia are as follows: There is always, and as the most prominent symptom, considerable pain in the spine. The pain in the spinal column is greatly increased by pressure, whether superficial or deep; by flexion, rotation, or downward pressure on the spine. It is augmented by pressing deeply into the inter-vertebral spaces on either side of the spine, and by the application of a hot sponge. The pain is not much, if at all, complained of when the body is at rest, or when the back is not pressed upon. It is more of the nature of tenderness on pressure than of actual permanent pain. This tenderness may be limited to one spot in the spine, and if so, is usually seated in the cervico-dorsal region. It may occupy several points, or it may extend over the whole vertebral column. It is always associated, when traumatic—and I am only speaking now of spinal anæmia, the result of injury—with cutaneous hyperæsthesia, often of a very intense character, diffused more or less extensively over the posterior part of the back, usually as far as the lateral median lines. In fact it corre-

sponds exactly to the distribution of the superficial branches of the posterior primary divisions of the dorso-spinal nerves. This hyperæsthesia is often so intense that the mere approach of the finger will occasion involuntary shrinking on the part of the patient, that it would almost appear as if the dress rather than the skin were the seat of the exalted sensibility. But intense as it may be, when the patient's attention is fixed on the approach of the surgeon's finger, yet if his mind is occupied by having his thoughts directed to other matters, the hand may be placed upon the back and carried down the spine without the slightest sign of suffering. It is much the same with movements of the body. If the surgeon flexes or rotates the spine, in order to test the existence of pain, the patient will cry out, writhe with agony, and complain loudly of the torture inflicted upon him; but if his attention is otherwise engaged he will rise off the couch on which he is lying, stoop, dress and undress himself without the slightest sign of suffering. This, which often throws suspicion on the *bona fides* of the patient, must not, for reasons that will be given in the Lecture on Diagnosis, be taken as an evidence of malingering. That he does suffer pain when his attention is directed to the part that is touched or moved there can be no doubt; that this pain is not permanent, or that it disappears when his attention is actively engaged elsewhere, and is as much dependent on the patient's mental condition as upon the state of the spinal cord, is equally certain.

In the more intense cases of anæmia of the spinal cord there is paralysis, more or less complete, of sensation, and often quite complete of motion in the lower extremities. Below a certain level in the dorso-lumbar region, in the greater part, if not in the whole, the nervous system appears to be completely exhausted, and its action almost entirely suspended. It is equally incapable of receiving and of transmitting impressions. The legs and feet are cold; there is no reflex sensibility or movement in them; they are not susceptible to the electric stimulus, either as regards muscular irritability or cutaneous sensibility. They are, of course, utterly unable to support the patient. The knees bend under him in a flaccid manner if an attempt is made to place him on his feet, and the legs fall heavily and lifelessly on the bed when raised from it. But notwithstanding all this local nervous exhaustion, it will be found that the sphincters are not paralysed, and the general health though enfeebled may be fairly good. The intelligence is usually perfect, though the brain and the eyes easily become fatigued, and the patient is thus equally incapable of sustained intellectual effort, or of continuous reading. The condition in fact is one of complete exhaustion of the spinal system below a certain level, that level usually corresponding with a line drawn round the body from the tenth dorsal vertebra. The condition of the inferior divisions of the cord, and of the nerves of the lower extremities in spinal anæmia, very closely resembles the perversion and suspension of functions met with in certain of the sensory nerves in the exhaustion of cerebral anæmia. The impairment of vision amounting at last to complete amaurosis, the tinnitus aurium going on to deafness of one or both ears after prolonged lactation and profuse hæmorrhages, are of this kind. Purely functional conditions dependent on the affected nerve being incapable alike of the reception and the transmission of sensory impressions.

As I have already remarked, this condition, which we call anæmia of the cord, is scarcely a pathological one. It is never fatal, and hence no opportunity has been afforded to pathologists of examining the condition of the parts after death. It is rather by clinical inference than by positive pathological observation that such a state can be

termed one of anæmia ; and in this uncertainty as to its true pathology, it may perhaps scarcely be desirable to attempt to give an explanation of the method by which such a condition of the cord is brought about. Whether it is by a concussion or vibratory jar in consequence of which its molecular condition is so disturbed that its functions become for a time perverted or suspended, or whether, as may not improbably be the case, the primary lesion has been inflicted upon the sympathetic system of nerves, in consequence of which the vascular supply to the cord may have become interfered with, and the symptoms that have just been described have directly resulted from a diminution of arterial blood transmitted to it, as the result of the disturbance of the vasomotor action of the sympathetic is uncertain. That the sympathetic is disturbed in many of these cases would appear to be probable, from the fact that this so-called spinal anæmia is frequently associated with derangement of function of the abdominal or thoracic organs, as shown by palpitations, vomitings, &c.

We will now proceed to the consideration of a condition of the nervous system that occasionally occurs as a result of spinal concussion, which appears in its clinical history, in its symptoms, and probably in its pathology, closely allied to anæmia of the cord, and which for want of a better name we are apt to call "Hysteria," that word which serves as a cloak to ignorance, and which simply means a group of symptoms all subjective and each one separately common to many morbid states.

But before proceeding to speak of hysteria as a result of concussion of the spine, let me say a few words about the different varieties of nervous shock, leading up to complete unconsciousness, that may result from these accidents.

It is important to observe that a serious accident may give rise to two distinct forms of nervous shock, which may be sufficiently severe to occasion complete unconsciousness. The first is mental or moral, and the second purely physical. These forms of "shock" may be developed separately, or they may co-exist. It is most important, not only so far as a prognosis of the patient's future state, but also so far as the recognition of his immediate condition is concerned, to diagnose between these two, and if co-existing to assign to each its proper importance.

The mental or moral form of unconsciousness may occur without the infliction of any physical injury, blow, or direct violence to the head or spine. It is commonly met with in persons who have been exposed to comparatively trifling degrees of violence, who have suffered nothing more than a general shock or concussion of the system. It is probably dependent in a great measure upon the influence of fear ; it partakes more of the character of syncope than of the true concussion of the brain, or of that extreme depression of the system that is consequent upon the infliction of a severe physical shock. It is never followed by those secondary effects that are so commonly met with after a shock has been inflicted by a direct injury to the head; spine, or, indeed, to the body generally. If it is followed by any after symptoms, these are usually of an emotional and possibly of an hysterical character. It will be found that as the patient recovers from the immediate and primary depression of the shock, he, or more frequently she, becomes greatly agitated, nervous, or truly hysterical, often manifesting great excitement, and being soothed and pacified with difficulty. This form of shock, even though it be attended by unconsciousness, is not followed by those after phenomena indicative of real or organic lesions of the brain, the cord, and their membranes, which so commonly result from physical shock. It is this condition that is so apt to lead to an emotional state, which, for want of a better term, may be called hysteria.

This mental state is one much more frequently met with amongst women than men ; but in men it is occasionally found as one of the sequelæ of railway injuries. I say of railway injuries, because it is the rarest thing possible to meet with it after accidents of any other kind. During a hospital practice of thirty years I can scarcely recall to mind a single case in which the emotional or hysterical state that I am about to describe has been met with after, or as a consequence of, any of the ordinary accidents of civil life. But I have seen many instances of it after railway concussions. Is this due to the frantic terror which often seizes upon the sufferers from railway collisions, or is it due to some peculiarity in the accident, some vibratory thrill transmitted through the nervous system by the peculiarity of the accident? I am disposed to think that terror has much to do with its production. It must be remembered that railway accidents have this peculiarity, that they come upon the sufferers instantaneously without warning, or with but a few seconds for preparation, and that the utter helplessness of a human being in the midst of the great masses in motion renders these accidents peculiarly terrible. In most ordinary accidents, as in a carriage accident from a runaway horse, the sufferer has a few minutes to prepare, is enabled to collect his energies in order to make an effort to save himself, and does not feel the utter hopelessness of his condition in his struggle for life and safety. The crash and confusion, the uncertainty attendant on a railway collision, the shrieks of the sufferers, possibly the sight of the victims of the catastrophe, produce a mental impression of a far deeper and more vivid character than is occasioned by the more ordinary accidents of civil life. Hence, I think, the greater degree of mental shock that accompanies them, and of the hysterical state that is apt to be induced by them.

The symptoms indicative of this emotional or hysterical condition are as follows :—The patient, after having been subjected to the disturbing influences of a railway accident, by which he has become greatly alarmed and agitated, but in which he has not received any direct or serious physical injury, may, for a few hours, or even for a day or so, possibly go about his business, but in a constrained and unnatural manner, before the emotional symptoms develop themselves. These then manifest themselves usually in the first instance by a violent fit of sobbing and weeping. He becomes alternately irritable and morose in character, emotional to a high degree, so that he bursts into tears, sobs if spoken to, especially in a kind manner, and at other times becomes irascible, and even threatens his family and those around him with violence. He becomes utterly unfitted for business or for the ordinary duties of life. Notwithstanding these nervous symptoms, his digestive organs do their duty naturally and well, and his various functions are healthily performed. He does not lose flesh, but he has a despondent and haggard look of countenance. It is alike impossible to reason with him or to console him. He nurses his symptoms, and dwells upon his sufferings, his losses, and his wrongs. If he has been struck on any part of the body, this will usually become the seat of pain. This pain is diffused ; does not affect the anatomical course of any particular nerve, and consists, in a great measure, of skin-tenderness. It is usually the spine that is thus complained of ; and although the patient suffers pain, which he describes in exaggerated language as of the most agonising and excruciating character, when lightly touched, not only over the vertebral column itself, but on almost any part of the skin of the back, he will move freely, walk about, get up and sit down, dress and undress himself, without such restrictions of his movements as would necessarily arise from the suffering that is the result of organic

disease. There is an obvious want of consistence between the freedom of his movements and the pain that is complained of on pressure on the affected part. So sensitive does he become to the touch that as soon as the surgeon lays his finger upon his coat, before the skin could have been impressed, he will start away as if he had been seriously hurt, and in some cases even he becomes nervous and excited if any person stands behind him. There is, in fact, that unconscious exaggeration of symptoms, and especially of pain, which is common to all hysterical people, that simulation or nervous mimicry of real disease which has been so well described by Brodie and by Paget. This state of things will last indefinitely without any very material change. There may be daily or weekly fluctuations, but the patient neither gets materially better nor worse. This state will continue, indeed, as long as the mind is impressed by the prospect of impending litigation. When once that has been removed, recovery, provided there be no organic complication, will take place so rapidly as to lead to the suspicion that the whole of the sufferings were purposely simulated, and that the patient was a malingerer. This conclusion may possibly be correct in some cases, but in others it is certainly unjust. Anxiety of mind has much to do with the development of the symptoms that I have just been mentioning. They arise in the first instance from the agony of fear into which some individuals are thrown on the occurrence of any great catastrophe. It is not given to everyone to be able to preserve calmness of mind in the midst of the crash and confusion of a railway collision, though it be not of the most serious nature; it is not given to everyone to be one of those whom *si fractus illabatur orbis, impavidum ferient ruinae*.

This state is maintained by anxieties connected with the collapse of business, and possibly of impending pecuniary difficulties occasioned by the forced relinquishment of work consequent upon the injury that the patient has sustained, and it is continued indefinitely by the harass of mind consequent on the litigation in which the sufferer becomes involved in prosecuting his claim for compensation. These anxieties once removed, the mental tone speedily becomes restored, that power of self-control which has been lost is regained, and the emotional condition and its concomitant phenomena, which are consequent upon a temporary suspension of the power of will, speedily disappear.

It is far too common a practice to treat this state either as being under the patient's control, or as being a condition of no material moment, inasmuch as it does not arise from permanent organic injury or disease. It is unjust, as well as irrational, to treat the condition as one of little moment. It is true that we are apt to speak lightly of hysteria in women. But in reality even in their case it is often a most formidable as well as intractable disease. We only know it by its effects. We use the term 'hysteria' to hide our ignorance of what this condition really consists. To me, I confess, the sight of a man of middle age, previously strong and healthy, active in his business and in all the relations of life, suddenly rendered 'hysterical,' not merely for a few hours or days, by some sudden and overwhelming calamity that may for the time break down his mental vigour, but continuously so, for months and even years, is a most melancholy spectacle, and is a condition that certainly to my mind is an evidence of the infliction in some way of a serious, and, for the time, disorganising injury of the nervous system, though, happily, that injury is not in general of a permanent nature, or attended by organic changes.

This emotional or hysterical state not unfrequently occurs as an independent affection, without any concomitant complication, yet cases every now and then occur in which there is real, possibly permanent and

larly in men, the diagnosis is by no means easy. In such cases the emotional state alternating with fits of irritability and of hypochondriasis closely resembles the early stages of cerebral softening. But the diagnosis may usually be effected by attention to this point, viz. : whether the symptoms have developed early after the accident and to their full extent, or have come on slowly and progressively at a late period. If early and fully, it is obvious that time would not have been sufficient for the development of cerebral softening. If slowly and progressively, and if dependent on this condition, other and unmistakable signs of mental decadence or of paralysis will soon show themselves, and time will certainly clear up all doubt on the diagnosis.

The hypochondriasis of oxaluria and the peculiar nervous state associated with that condition have many points of resemblance to hysterical shock ; and indeed it is quite possible that oxaluria may be occasioned by the mental anxiety and depression consequent on a railway injury. In all cases of doubt the microscopical examination of the urine will at once solve the difficulty as to the diagnosis, though it does not determine whether the oxaluria be the cause or the consequence of the nervous depression with which it is associated. In primary oxaluria, however, I am not aware of diffused hyperæsthesia being a permanent symptom as it is in most cases of hysterical shock.

Unconsciousness, insensibility, stupor, or syncope frequently occur in connection with concussion of the spine and shocks to the nervous system in railway and other accidents. It is impossible to overrate the importance of the production of unconsciousness by and at the moment of the occurrence of the accident. It is of itself, and irrespective of any other condition, the evidence of the infliction of a severe shock upon the brain, even though no blow has been inflicted upon the head, and the violence has only consisted in a general concussion or jar of the whole body. If the brain be in any way concussed to such an extent as to become unconscious of surrounding conditions and of all external influences, an immediate or primary impression of the most serious character must have been inflicted upon it, and any after or secondary consequence may become possible. No after consequence, indeed, can possibly be so serious as is that immediate annihilation of all sense and consciousness on the receipt of the injury, which is manifested by the sudden production of insensibility. The commotion that the brain substance sustains at the moment that the patient is stunned may lead to changes that may eventually result in the worst possible forms of organic disease, paralysis, epilepsy, or cerebral softening. But for the unconsciousness to be of full and grave clinical value it must be immediate ; it must be contemporaneous with the receipt of the injury ; it must be the direct and instantaneous effect of the physical shock that the brain has sustained directly by a blow on the head, or indirectly by general concussion of the body transmitted to it. It is only under these circumstances that it is of the nature of true concussion of the brain, and that it is really grave. This kind of unconsciousness, which is physical in its cause, and may be full of importance in its results, has, I believe, always this peculiarity, that on the sufferer regaining his consciousness there will be found to be a loss of recollection of something if not of all that is connected with the accident. The memory will be perfect up to one point ; but then there will be a gap which the patient cannot possibly fill up ; there may even be loss of memory (and this does not unfrequently occur) of some of the circumstances that immediately preceded the infliction of the injury. Thus, for instance, a driver will remember his horses running away, but he will not recollect how he was thrown from the coach-box, an event which necessarily occurred, before

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thrown from the coach-box, an event which necessarily occurred, be

he struck his head upon the ground, and thus was rendered unconscious. This loss of memory of events immediately antecedent to, as well as those actually connected with, the infliction of the injury, is a very remarkable circumstance, and may be taken as a positive proof that the brain-substance has sustained a severe commotion or physical lesion. The chain of memory is broken abruptly at some occurrence often of a very trivial character antecedent to the accident, and the gap left can never be filled up by any mental effort on the part of the patient.

But there is another kind of unconsciousness of a totally different character: this is the emotional, not physical, form of insensibility. This form of unconsciousness partakes more of the character of syncope than of shock. It differs from the true physical stunning in this, that it does not usually occur at the moment of the accident, but generally immediately afterwards. It arises from shock to the mind, and not from physical lesion of the brain structure. It is the result of terror, of the horror of the situation, of the painful sights witnessed, possibly of the pain suffered by the patient from the infliction of some wound. This form of syncopal unconsciousness differs from physical insensibility not only in not being immediate, and in occurring a few moments after the accident, but especially in not being followed by the obliteration of all recollection of the event. Indeed the concomitant circumstances of the accident which has occasioned it are usually most strongly, minutely, and indelibly impressed on the memory. It is of the character of swoon or faint rather than of brain shock, and leaves no after consequences of a serious character.

LECTURE IX.

ON THE COMPLICATIONS OF CONCUSSION OF THE SPINE, AND ON THE INFLUENCE OF INJURY OF THE PERIPHERY OF NERVES ON THE CENTRAL PORTIONS OF NERVOUS SYSTEM.

INDEPENDENTLY of those lesions which are more especially referable to the nervous system and the organs of sense, there are several complications which are specially apt to occur in cases of concussion of the spine. These complications often assume a very prominent character, and tend to divert attention from the real and primary injury of the nervous system.

These complications consist of sacrodynia, vomiting, discharge of blood from the bowels, laceration of mucous membrane of rectum, mucous desquamation from colon and rectum, suppression, retention, and incontinence of urine, hæmaturia, diabetes, and phlebotic thrombosis. We shall consider them briefly and solely as complications of the condition I am now describing. In addition to them I shall say a few words on the effects of peripheral injuries of nerves on the nervous centres.

Sacrodynia.—Severe blows on the sacral, gluteal, and lower lumbar regions frequently occasion concussion of the spinal cord, and even of the brain. Even though the symptoms of concussion of the nervous centres arise from more direct injury of the spine or head, yet in the accident that causes them the sacro-lumbar region may be violently struck. This is very frequently the case in railway collisions, where the sufferer is thrown forwards and then jumped backwards against the hard seats or unstuffed partitions of second and third class carriages. The

effect of such blows or bumps as these is to develop a class of symptoms that may exist independently of those of spinal concussion, or that may be associated with them, and by this association not only very materially to complicate the diagnosis of the case, but to add greatly to the patient's sufferings and disabilities.

This group of symptoms, to which I give the name of *Sacrodynia*, are as follows: Soon, but not necessarily immediately, after the accident the patient feels a diffused pain over the whole of the sacral and sacro-lumbar regions. It is usually most intense over the sacrum, and more especially over the sacro-iliac synchondrosis; but it is by no means confined to this part. It extends upwards as high as the fourth or even the third lumbar vertebra, and laterally perhaps to within an inch or two behind the trochanters. But the sacrum is the focus of greatest intensity. When the sacro-iliac junction also is the seat of suffering, it is in the majority of cases the left one. Over the whole of this region there is tenderness on pressure, and the pain is greatly increased by movements of all kinds. There is no nocturnal exacerbation. There is no external sign of injury, in the way of swelling, heat, or discoloration. The patient cannot hold himself erect without an increase of the pain, hence he has a tendency to stoop slightly forwards, and perhaps to incline to one side. Advancing the lower extremities increases the pain greatly, the patient therefore walks with difficulty, takes short steps, leans on a stick, and when one side is more painful than the other, drags the leg on that side. As I have already said, the left side is more commonly the one that is most painful, hence it is that the left leg is so frequently 'dragged' in these cases. The greater frequency and the greater degree of sacrodynia on the left side than on the right, and the consequent drag of the left leg, are very notable circumstances. They occur in at least three-fourths of all the cases. The only explanation that I can give of it is this. In a railway collision, when a person is thrown forwards he naturally thrusts out his right hand more than the left, in order to save himself, and to clutch at some object for support. In doing so he turns the whole of the right side forwards, and when thrown back again on to the seat or partition in the rebound of the carriage, he strikes first, and with greatest violence, the left side of the pelvis, which is slightly rotated backwards.

The duration of these symptoms is very prolonged. When once they have fairly set in, they will last for many months, often for a year or two.

This condition is a very serious one, not on account of any danger to life or limb, but owing to the pain in standing and moving incapacitating the sufferer for all active exercise and exertion, and thus materially restricting the enjoyment and usefulness of life.

In its pathology sacrodynia seems to resemble coccydynia, as it does indeed in its symptoms and duration. The pain does not follow the anatomical course of any nerve, and cannot therefore be referred to the class of neuralgias. It appears to be the result of direct bruising of the extensive planes of aponeurotic and fascial structures in this region, with sprain of the various ligamentous structures there met with. The sacro-vertebral, the ilio lumbar, the sacro-iliac, and the great sacro-sciatic ligaments may all be more or less strained in the bumps, twists, and wrenches to which the pelvis and lower part of the spine are subjected in the accidents under consideration. And according as the violence falls more or less directly on one or other of these ligaments, so the patient will suffer more or less in the parts where it is situated. The long duration of the pain in these cases of sacrodynia is just what we find in all cases of ligamentous strain elsewhere.

The diagnosis of sacrodynia has to be made from 1. Rheumatism.
2. Spinal concussion.

1. From rheumatism, whether it shows itself in the form of lumbago or sciatica, the diagnosis is easily made by attention to the seat of the pain, which, in lumbago, is above the ilium and on either side of the lumbar spine; in sciatica, along the course of the greater and upper sciatic nerves, and by the absence of nocturnal exacerbations or of climatic influences in sacrodynia. The following method may be relied on as effecting at once the diagnosis between sacrodynia and sciatica. Place the patient in the recumbent position, fix the pelvis and extend the leg, then place one hand on the knee so as to prevent its being bent, and with the other draw up the foot forcibly so as to depress the heel and thus put the sciatic nerve on the stretch. If the pain be due to sacrodynia it will not be increased by this manœuvre; if due to sciatica, it will be greatly aggravated when the nerve is thus stretched out. The total absence of those constitutional derangements which are common in rheumatism, and the usual co-existence of a state of great nervous depression in sacrodynia, will tend to make the diagnosis more easy.

2. From spinal concussion the diagnosis is not always so easy, and indeed I have frequently seen these cases of sacrodynia mistaken for and treated as cases of spinal concussion. The mistake is the more liable to occur as the dragging of the leg seems paralytic, when in reality so far from being dependent on loss of innervation, it is in reality due to the pain that is occasioned when any attempt is made to move the leg forwards, and thus to put the injured ligaments on the stretch. From the nervous symptoms resulting from spinal concussion the diagnosis may thus be made by attending to the seat of the pain, and by the absence of all the special symptoms that characterise the nervous lesion. But it is very important to bear in mind that in a very large proportion of cases sacrodynia is associated with spinal concussion, and that the symptoms of the two conditions co-exist. The diagnosis must then be effected by a careful examination of the spine whilst the patient is lying down in the prone position, and the pelvis is freed so as to take off all weight from it, and to prevent all movement between it, the sacrum, and the lumbar vertebrae.

The dragging of the limb which gives this paralytic appearance to patients suffering from sacrodynia may be diagnosed from true paralysis by finding that when the patient is recumbent the movements of the foot, the electric sensibility and irritability, are perfect.

The diagnosis from coccydynia, and from the diffused pain of table ulcer of the rectum, is readily made by the ordinary examinal digital and ocular, of the parts.

Nerve Complications.—Any affection of the nerves of the face is early a very serious complication, as it indicates either primary or secondary mischief of the brain-meninges or of the brain.

The portio dura of the seventh nerve is the trunk most frequently thus affected. The motor nerves supplying the eyeballs are rarely so; the lingual nerve but rarely.

Any loss of power, however slight, about the mouth must be carefully watched, and cannot but be regarded as a tension of mischief upwards. Drooping of the angle of the eyelid, inability to whistle, to sniff, to knit the lips, the tongue to the sides (not to be accounted for by any other cause) are important signs.

In some cases instead of paralysis there is spasm produced by the facial nerve. In this case the spinal cord is commonly found to be similarly affected, and the

ings often of a very marked character every few minutes, not only of the side of the face, but of the muscles supplied by the spinal accessory, so that the head is jerked downwards, and to the sides.

This unilateral clonic spasm of these nerves is not unfrequently the precursor of epilepsy or of hemiplegia.

I have seen cases of concussion of the spine with no external sign of injury, and few, if any, serious symptoms in the early stages, gradually go on through a long series of progressive developments, extending through many months, to clonic spasm of the muscles supplied by the facial and spinal accessory nerves, spasm of a clonic character excited by touching the skin of the face, brushing the hair on the affected side of the head, pressing upon a tender spot in the cervical spine, exercising pressure with the finger over the sub-occipital or supra-scapular nerves, and terminate at last in creeping paralysis of the leg, short but frequently recurring epileptiform seizures and hemiplegia.

The fifth pair of nerves as a whole, or in any of their branches, appears to be remarkably free from paralytic affections. I have never seen anæsthesia of the face as a consequence of general nervous shock, or as a sequence and complication of spinal concussion. The only condition approaching to paralysis of any branch of the fifth that I have had occasion to observe has been numbness of the teeth on one side, sometimes in the upper, at others in the lower jaw. But in these cases there has always been a direct blow on the face, and the numbness was primary and immediate, though in some cases very persistent. Hyperæsthesia of the fifth is equally rare.

Syphilis.—The question may arise as to how far the symptoms may arise from syphilitic disease of the brain or cord or their meninges rather than from concussion of the nervous centres. I have seen several instances of this not only after railway collisions, but in accidents in a gymnasium, by the overturning of a carriage, &c.

When the patient is actually suffering from the more advanced forms of constitutional syphilis, the difficulty in the diagnosis, and in the degree of relation that the symptoms bear to syphilis, or to injury, may be very great. The error must not be committed of looking at the paralysis as necessarily the result of syphilitic disease of the cord or its membranes merely because it co-exists with manifestations of constitutional syphilis. The paralysis of a syphilitic patient may be traumatic, and not in any way connected with or dependent on the specific taint in the system. Careful attention to the history of the case and the mode of progression of the symptoms may do much to unravel the tangle of this complication; but there are two or three points that deserve special consideration. Thus the ptosis strabismus and double vision which are so common in the syphilitic forms of brain disease are very rare after spinal concussion. Thus also the comparatively early occurrence of epileptiform or comatose symptoms in the specific constitutional disease should be noted. In concussion of the spine also there will be spinal tenderness and pain in movement of a marked character, which does not occur in syphilitic disease.

The following case will illustrate some of these points:—

Case 43. Fall in Gymnasium—Blow on Back—Slow Development of Spinal Symptoms—Constitutional Syphilis—Were Symptoms due to Injury or Syphilis?—An officer, aged 27, fell whilst 'playing tricks' with a companion in a gymnasium, and was struck in the middle of the back. He suffered a good deal at the time, was laid up for a week, and gradually got about so as to be as active as before. He contracted syphilis, and had secondary symptoms. Two years and a half after the accident he began to drag the right leg, which became wasted, was cold and

numb ; his sight became affected ; there was external strabismus of the left eye and double vision ; he had some scaly syphilides occasionally appearing on the body ; the right leg was found on measurement to be rather more than half an inch smaller than the left ; there was no spinal pain or tenderness on pressure of any part of the vertebral column.

Were these symptoms referable to the accident or to the constitutional syphilis ? The history of the case, the lengthened interval between the fall and the paralytic symptoms, the existence of secondaries, the absence of all signs of spinal irritation, and the strabismus, all pointed to syphilis as their cause. He was treated with large doses of iodide of potassium, iron, and with galvanism, and made a good recovery.

Extreme cardiac debility is a very frequent complication of spinal concussion. The heart's action is extremely feeble, the sounds faint and distant, the pulse weak and compressible, and the patient liable to attacks of cardiac syncope. This condition often lasts many months, and may possibly become permanent. It is a question for investigation whether it results from direct shock to the heart through the cardiac nerves, or whether it is occasioned more indirectly by the injury that may possibly have been sustained by the sympathetic. I have more than once observed great difference in the size of the pulse in the two wrists as a secondary effect of spinal concussion, and probably of implication of the sympathetic.

The next complication to which I wish to direct attention is *vomiting*. Now vomiting in such cases may be of two kinds : there is the ordinary vomiting that occurs on recovery from concussion of the brain from any cause, and which tends so materially by driving the blood to the head to restore consciousness. But there is another kind of vomiting which is apt to occur in a more continuous manner as a consequence of concussion of the upper part of the cervical spine. The characteristics of this vomiting are, that it continues for weeks or months, that the contents of the stomach are ejected without force or strain, that they consist chiefly of masticated food that has undergone but little change, and that in consequence of the persistence of this condition the patient's health and strength become greatly wasted. The following case will illustrate this point.

Case 44. Blow on Cervical Spine—Long-continued Vomiting—Partial Paralysis.—G. D., a man about 27 years of age, met with an accident in a railway collision, in the early part of April, 1867, in which he was probably struck across the nape of the neck. For ten days he was confined to his bed, suffering severely from pain in the upper part of the neck. Mr. Gisborne, of Derby, who saw him, states that at this time he was pallid, looked anxious, complained of pain in the back of the head ; was restless at night, and had constant sickness after taking food, whether fluid or solid. His pulse was slow, his breathing oppressed from a sense of suffocation, accompanied by very uncomfortable sensations about his heart. The patient made little improvement, and was brought up to London, where I saw him on May 13. I found him looking thin, pale, and anxious. He stated that he had not had a day's health or freedom from pain and distress since the time of the accident. He complained chiefly of pain in the back of the head. This pain was increased by moving the head to and fro, by rotating it, and by pressing it down on the spine. It occurred at the moment of the accident, when he felt a shock as if he had received a blow from a sledge-hammer, which was immediately followed by a severe pain shooting down to the region of the heart, and by an attack of vomiting. Mr. Evans, of Derby, under whose care the patient had been, confirmed the account he gave of himself. Vomiting had continued daily ever since

the accident, in fact he vomited several times in the course of each day, and had done so up to the time of my seeing him. The breathing had also been affected, being shallow, panting, and oppressed. When he received the blow, he had a sense of suffocation, and great oppression about the region of the heart. I saw G. D. again on November 5. I found him worse in certain material respects. The vomiting continued, and he complained much of pain in the back of the head; but in addition to this he had partial paralysis of the right arm and leg. The arm was numb, with a feeling of tingling throughout it, but more particularly along the course of the ulnar nerve. The fingers were contracted, he had a difficulty in opening them, and the grasp of the hand was extremely weak. The right leg was weak, numb, and cold. On measuring it, I found that in the middle of the thigh it was one inch less in circumference than the left one on a corresponding line, and that the right calf was five-eighths of an inch smaller than the left, showing clearly that the nutrition of the limb had been affected. On enquiring into the particulars of these new symptoms, I learned from Mr. Evans that the patient had had a 'fit' on June 16, and that on his recovery from a state of unconsciousness the symptoms of paralysis had manifested themselves.

On December 6, I again saw G. D., in consultation with Dr. Reynolds. At this time we found that there were twitchings in the muscles of the right limbs, that the loss of power in them had been progressive, and that although the vomiting had been less frequent, the paralytic symptoms had appeared to increase. The patient was thinner, more haggard and worn in appearance, than at his last visit. It is important to note that I had frequent opportunities of observing the vomited matters; they were perfectly sweet in odour; there was no bile or acid, or glairy mucus about them, no appearance, in fact, of disease. They seemed to consist simply of partially digested food. It would appear from the symptoms of vomiting, suffocation, and oppression about the chest, that the patient had received an injury somewhere about the origin of the pneumo-gastric nerve in the course of the respiratory tract, and indeed, the pain that he suffered at the back of the head would indicate that this was the seat of his disease. He was put under treatment consisting of rest, active counter-irritation by repeated blistering, and small doses of calomel. The case came to trial, and so far as all compensation claims were concerned, they were favourably adjusted, and the patient improved, but very slowly. On January 19, 1871, nearly four years after the injury, Dr. Evans wrote to me that G. D. still suffered from pain at the back of the head, aggravated at times. When very bad, he became sick and vomited as before, but these attacks were less frequent than they used to be. The paralytic affection of the right leg and arm had improved: he could now use these limbs more freely, and could bear a moderate amount of exercise. There was also a decided improvement in the muscular development in the limbs, and the measurement of the two legs was equal; but he suffered from want of sleep, and was at times much depressed in spirits. Although his improvement had been considerable, it is evident that at this period it was far from complete.

Another symptom closely allied to vomiting is *Hiccough*, which, though less serious, is often very distressing and painful.

Intestinal Complications.—In consequence of the strain to which the body is subjected, considerable intestinal disturbance not unfrequently takes place, and occasionally this will be followed by copious evacuations of blood *per anum*, continuing through a period of many months. In one case which I attended with Mr. R. Dunn, these bloody stools con-

tinued for nearly a twelvemonth. They are altogether unconnected with hæmorrhoids, and usually consist of dark, semi-coagulated blood. The evacuation is accompanied by a good deal of faintness.

In other cases again, one of the most marked symptoms consists of a copious discharge of intestinal mucus in large shreds and flakes, and in very considerable quantity. It would appear as if the shock had in some way damaged, possibly lacerated or inflamed, the mucous membrane of the colon. This condition was very strongly marked in the following case.

Case 45. Shock from Fall—Laceration of Mucous Membrane of Rectum—Colitis—Epithelial Desquamation.—Miss W. was injured in February 1868, by falling heavily upon the ground in consequence of putting her foot into a hole in a door-mat in the waiting-room of the railway station at Spalding.¹ She was a woman of active habits, a dancing-mistress by profession. She was seen by Sir Cordy Burrows and Dr. Taaffe, of Brighton, who referred her to me. At the time of our examination we found that she was suffering from a concussion of her spine and a shock to her general nervous system, and that she had in addition some injury to the lower bowel. This proved on examination to be a longitudinal fissure of the mucous membrane at the posterior part of the anus and lower part of the rectum. She had suffered since the time of the accident from constant pain in the back, confusion of thought, numbness in her limbs, and a feeling as if cold water were running down her back; a sensation of being grasped on both sides of the pelvis; a sense of constriction as if by a tightened cord round her abdomen, and also round the chest, just below the breasts. She suffered great pain in the abdomen when the bowels were moved, and about June 4 she noticed that she was passing shreds with the fæces, which on microscopical examination proved to be portions of the epithelium of the lower bowel. She had since almost daily continued to pass these shreds, with, at times, some muco-purulent discharge. I saw her again about this time, and found that she was suffering from ulceration of the mucous membrane of the rectum, in which there was a fissure. I advised the usual operation of partial division of the sphincter, which was done, with considerable relief, which continued for about three weeks, when the symptoms returned, the portion of the mucous membrane inside the anus appearing healed, but the upper portion of the lower bowel was very much irritated. This patient continued to pass enormous quantities of large flakes of shreddy epithelium mixed with mucus. This continued for a great length of time. On November 13, 1869, a year and three-quarters after the accident, I found that this epithelium was still being discharged, though in lessened quantity. Miss W. was very nervous and weak, scarcely able to walk; in going downstairs had to do so backwards, and was quite unfit for her profession,

¹ This case involved an important legal point which has a direct bearing upon, and shows the responsibility entailed by, persons engaged in business or profession. It amounts to this, that a person who opens his house for the purpose of gain renders himself liable for any injury sustained by one of his clients, patients or customers, on entering or leaving that house, that is occasioned by the negligence of himself or his servants. But he is not liable in the case of any individual coming to the house as a mere visitor. Thus, as was stated in this case by Mr. (now Lord) Coleridge, if a patient or client in going to the house of a medical man or solicitor to consult him professionally, tripped in a hole in the carpet or fell over a loose stair-rod, and injured himself, his professional adviser whose counsel he was about to seek and pay for would be liable for the injury sustained. But if the person come as a friend, or simple visitor, and the house was opened not for the purpose of gain, the occupant would not be liable. The case of Miss W. was tried at Guildhall on June 28, 1869, and a verdict for large damages was taken by consent.

which, indeed, she was obliged to relinquish. From this time she slowly improved, and eventually recovered, but for a long time continued to suffer from sacrodynia and epithelial discharge. Since this case occurred, I have seen several others in which laceration of the rectal mucous membrane resulted from falls or blows in the sacral region.

The three following cases illustrate various complications of shock in the nervous system in ordinary accidents and in railway collisions, in derangements of the thoracic and abdominal organs.

Case 46. Fall on Ice—Hæmaturia and Hæmorrhage from the Bowels, with Contractions of the Flexors of the Legs, following Falls on the Back.—A lady was sent to consult me by Dr. Graves, of Gloucester, on July 23, 1872, and gave the following history: She was unmarried, and aged 57. Twenty years ago she fell on her back on the ice and was severely shaken. The same evening she had hæmaturia. This was soon arrested by treatment, but had recurred occasionally. A few months after this she slipped in going down stairs, and struck her spine against some of the steps. The accident was followed by severe pain and loss of power in her limbs, and eventually by contraction of the flexors of the feet, so that her heel was raised nearly an inch from the ground. Subsequently hæmorrhage from the bowels took place, which had continued from time to time. The blood was usually bright, but sometimes dark-coloured. She had no piles or obvious cause for the bleeding.

Case 47. Shock to Nervous System in Railway Collision—Various Complications connected with the Thoracic and Abdominal Organs.—Mrs. T. aged 28, a healthy strong woman, was in a railway collision on November 12, 1869. She was jerked off her seat, fell to the bottom of the carriage, where she was bumped backwards and forwards against the edges of the seats. She became insensible, and was a good deal bruised across the loins. I saw her in consultation with Dr. Sedgwick, on November 26, a fortnight after the accident. She was then in an extremely prostrate state. On examining the back, there seemed to be some slight prominence of the third lumbar vertebra, and a twist of its spinous process to the right side. She had vomited repeatedly for twenty-four hours after the accident, then several times daily during the following week, and latterly only occasionally. The vomiting was altogether independent of the food that she took. The abdomen was very sensitive to the touch. She suffered great pain, referred to the upper part of the rectum in defæcation, and for eight days after the accident she passed great quantities of blood *per anum*. She suffered greatly from palpitation of the heart, nervous agitation, frequent interruptions of sleep, and frightful dreams. Her sight had become weakened, so that she was unable to read. There was a remarkable difference in the pulse at the two wrists, that in the left radial was so small and indistinct that it was impossible to count the beats; that on the right was moderately full and strong, 88 in the minute. This continued for several days, but gradually the pulsation in the left radial had become fuller and nearly equal in volume to that in the right. She remained in bed for nine days, when the railway surgeon who saw her advised her to get up and move about. She attempted to do so, but suffered excessive pain in the back, extending up to the head, and found she was quite unable even to stand, the attempt making her much worse for several days. When I saw her on the 26th, the condition above described generally continued. The spine was excessively tender, with violent pain on movement of any kind, more especially on pressure and rotation. When the pelvis was fixed and the body rotated, the pain was very intense. The urine was healthy in character; there was no irritability of the bladder. The treatment prescribed was rest, hot fomenta-

tions to the back, small doses of perchloride of mercury and bark ; under which plan she gradually mended. The points of interest in this case were the continuance of vomiting for several days, the passage of blood *per anum*, severe palpitations of the heart, the difference in the pulse in the two wrists, which gradually disappeared, the twisting of the spinous process of one of the lumbar vertebræ, and the general shock to the nervous system as indicated by the nervous agitation, the failure of sight, insomnia, &c.

Case 48. Severe Shock in Railway Collision—Blow on Right Side—Long-continued Vomiting—Gradual Development of Paraplegia, with Rigidity and Signs of Spinal Meningitis.—W. B. was in a railway collision on November 6, 1867. I saw him for the first time on March 28, 1868. He gave the following history. At the time of the accident he was struck on the right hypochondrium and across the loin on that side ; he was severely shaken but not rendered unconscious ; he was able to walk some little distance ; he got on to the step of an omnibus and drove home. About half an hour after the accident he vomited a quantity of blood. He gradually lost power in the lower extremities, and when I saw him, presented the following symptoms : There was no pain on pressure on any part of the spine, but considerable tenderness over the sacrum. The vomiting with which he had been seized immediately after the accident continued daily for about two months, and then ceased. There were slight paralytic symptoms about the face, some dropping of the mouth on the right side, a slight twist of the tongue, and dilatation of the left pupil. His mental condition was very emotional, approaching to the hysterical state. He had lost from two to three stone in weight in the course of four months. There was incontinence of feces, and partial loss of control over the bladder. The abdominal muscles were extremely rigid, hard, and tense ; the lower limbs were quite powerless. The muscles of the thighs and legs were rigid, so that the knees and ankles could only be bent with difficulty, and any attempt at movement caused extreme pain. There was no sign of palsy or of muscular relaxation, but the limbs lay stretched out in a rigid manner like those of a corpse. On making an attempt to bend the joints the whole limb was lifted up. There was almost complete loss of sensation below the knees. The skin could be pricked, pinched, and the cuticular hairs pulled, without any feeling. No reflex action was excited on tickling the soles of the feet. There had been no cramps or convulsive movements in the limbs. There can be little doubt that this condition, which slowly supervened after the accident, was dependent upon spinal meningeal inflammation.

The urinary organs frequently suffer from the concussion to which the spine and pelvis are subjected. In some cases there occurs a combination of retention and partial suppression of urine which is very remarkable and peculiar to this class of injuries.

Case 49. Blow on upper part of the Cervical Spine—Retention of Urine for three days.—In a man about fifty years of age, who had received a severe blow in a railway collision on the upper part of the cervical spine, whom I saw in consultation with Mr. Heath, in June 1874, there had been retention of urine for nearly three days after the accident, but without any great distension of the bladder. It then began to dribble away, and the organ emptied itself without need of the catheter.

In another case which I saw some years ago with Dr. Bonny, the retention of urine had lasted for forty hours, and in another case, no urine had been passed till the third day, by a young man of 22. In none of these cases does the bladder appear to have become over-dis-

tended. It would therefore seem that there had been suppression or arrest of secretion to some extent, as well as retention. It is possible that there is suppression for a time—that the kidneys do not secrete for many hours, after having been concussed. As they recover from the effects of the shock they slowly begin to secrete again, and then the bladder, which has been temporarily paralysed—stunned, as it were—fills up to a certain point, and incontinence of urine sets in with partial retention. Throughout the course of these cases of nervous shock or of spinal concussion, there may be every possible degree of retention or incontinence of urine, singly or combined, dependent upon more or less paralysis of sensation or of motion, or both combined.

Hæmaturia will occasionally occur, and in those cases in which I have seen it, the bleeding has always been venous. When this symptom is met with it will be associated with diminished secretion of urine.

Diabetes I have never seen occur as a consequence of any of these injuries of the spine, but have several times met with it as a consequence, sometimes temporary, at others more enduring, of injury to the posterior part of the brain. I have, however, seen spinal concussion in previously diabetic subjects. In these cases the injury to the nervous system very seriously aggravates the diabetic symptoms, increases the quantity of sugar, and materially hastens a fatal result.

Phlebitis. Among the distant complications of spinal injury it is necessary to include *embolism* and *thrombosis* of the larger veins. I have seen this happen in several cases, and I would especially refer to Cases 22 and 37, in which this occurrence will be found described as one of the more remote symptoms. This plugging of the veins, phlebitis, if you choose to call it so, commonly occurs in the lower extremities, and I imagine that it must be looked upon as a consequence of the absorption of blood that has been extravasated into the spinal canal. In both the cases to which I refer, that would appear to have been the nature of the lesion that occasioned the paraplegia. These cases of phlebitic embolism, consequent upon spinal concussion and intra-spinal hæmorrhage, resemble, therefore, in their cause, very closely, similar conditions of veins that are not unfrequently met with consequent on the absorption of disintegrating masses of blood coagulum, and extravasations into the general areolar tissue. In one of the cases referred to the patient nearly lost his life from acute inflammatory congestion of the lungs, with effusion into the pleura, undoubtedly due to embolism of the pulmonary vessels.

The complication of *pregnancy* with spinal concussion is always a serious one, not so much in regard to the duration of the pregnancy as to the prospect of recovery from the injury to the nervous system. Pregnant women who suffer from spinal concussion do not appear to me to have any special tendency to miscarry, but they are peculiarly slow in recovering from the symptoms of nervous shock or paralysis, after the confinement is over. Not only do these symptoms continue during pregnancy, but there is usually little prospect of amelioration for some months after parturition, more especially if lactation be permitted, which tends still further to retard recovery.

We will now proceed to discuss a subject of great importance, and one that has not as yet received the attention it deserves, viz., *the influence exercised by injury of the periphery of a nerve in exciting slowly, but progressively, disease in the nervous centres.*

It has long been known to surgeons that incisions or punctures of nerves are often followed by reflex phenomena of a serious and painful character. And it is remarkable that these phenomena are chiefly met with when the cutaneous filaments of the nerves of the upper extremity

are the seat of lesion. In fact it is rather when the peripheral terminations than when the nerve-trunks are wounded that they manifest themselves. And in some cases they would appear to have led to symptoms which were clearly indicative of central nervous irritation. Wounds of this description were more common formerly than now, for they often occurred during the ordinary operation of venesection. And without going so far back as the account given by Ambrose Paré, of the painful contraction of the muscles of the arm with which Charles IX. of France was affected for three months after an accident of this description, I would refer you to the works of Joseph Swan for several cases in illustration of it. In one case especially, the patient, a woman, who had been bled in the median vein suffered severe pain afterwards up to the shoulder for two days, and was seized with violent convulsions, which suddenly ceased on Mr. Swan making a transverse incision, about an inch in length, above the opening in the vein, so as to divide the wounded cutaneous nerve. I have seen more than once, in cases of dislocation of the fingers or of fracture of the phalanges, patients suffer much from cramps and contractions of the muscles of the forearm and arm almost of a tetanic character.

The digital nerves, indeed, are those the injury of which is especially apt to be followed by painful reflex contractions of the muscles of the arm, and in some cases by more serious after-consequences indicative of lesion of the nervous centres. Messrs. Banks and Bickersteth¹ have especially directed attention to this subject in a series of most interesting cases. In none of these, however, did the irritation assume a central character. But that cases do occasionally occur in which in consequence of lesion of the digital nerves by bruise or crush, symptoms of progressive mischief of the central portions of the nervous system may develop themselves is as undoubted, as it is pathologically interesting and clinically important.

That irritation, whether it be physiological, traumatic, or pathological, of the periphery of a nerve may give rise to acute disease in the nervous centres, is familiarly illustrated by the convulsions of dentition, by tetanus induced by the wound of a nerve in the foot or hand, and by muscular contractions dependent upon intestinal irritation. It is also a fact admitted by physiologists, that the lesion of a nerve-trunk may be propagated upwards to the cord, and produce secondary disease there. There is a class of cases, however, occasionally occurring in surgery, of which I have now seen several instances, in which it would appear that the injury done to the peripheral termination of a nerve in one of the extremities, may induce slow and progressive disease, leading on to structural changes of a chronic character in the brain and spinal cord, rather than those which take the form of acute convulsions or tetanic attacks. These cases are important, not only in their clinical and pathological, but in their medico-legal aspect. The following is a good illustration of them.

Case 50. Crushed Finger—Tetanic Spasms—Symptoms of Cerebral Softening—Death.—A gentleman, aged 60, in good health, when travelling to the city on March 24, 1866, on one of the suburban lines of railway had one of his fingers crushed between the door and its frame on the hinge side. The accident gave rise to great pain, and to some loss of blood. The sufferer returned home faint and exhausted with the shock. He was seen and the finger dressed by Dr. Wightman who found there had been considerable contusion and laceration of its extremity, but that the bones were uninjured. The wound healed

¹ *Liverpool Medical and Surgical Reports*, vol. iii. p. 64.

slowly but satisfactorily, yet the patient, who was in robust health and weighed about twenty stone at the time of the accident, lost flesh, became weak, and never seemed completely to rally from the shock that he had sustained. In the course of a month, twitchings, shooting pains, and cramps in the arm, somewhat resembling slight tetanic spasms, developed themselves. On April 29 he had a slight fit. This was followed by numbness, sensations of pins and needles in the hand and arm, twitchings of the face, a sense of weariness and of weakness, and although he had previously to the accident been a strong man, he was now unable to undergo even slight exertion without much feeling of fatigue. He, however, returned to his business as a house agent, and for six months continued it intermittently. He was then obliged to relinquish it, grew slowly and gradually worse, and eventually died, with symptoms of cerebral softening, on September 13, 1867.

Previously to this he had been seen by Mr. Le Gros Clark, and a consultation had been arranged on the day of his death, which was sudden. The question arose as to how far these symptoms were connected with the accident, and after a careful review of all the circumstances of the case, we came to the opinion that the injury received in the hand was the exciting cause of the affection of the nervous system which ultimately resulted in his death. The circumstances that mainly led to this conclusion were the following: That up to the time of the accident the patient had been in robust health; that the injury was immediately followed by severe and prolonged nervous shock, and by signs of local nervous irritation in the arm; that he never subsequently recovered from these symptoms, which were continuous, without a break, and though at times somewhat fluctuating, were, upon the whole, slowly progressive, the disease which originated in the injury having, in point of fact, an uninterrupted history from its origin to its fatal termination; that the hand and arm of the injured limb were the primary seats of the local disease which spread upwards to the nervous centres; and that death resulted from cerebral disease which presented all the signs of softening of the brain.

The widow of the patient brought an action against the Company, under Lord Campbell's Act, and obtained a verdict.

Since this case occurred I have seen at least two very similar to it. In one of these a medical man sustained an injury of the finger, this was followed by pains and convulsive twitches in the arm, a progressive break-down in health, and death in about a year. We have yet to learn the history of the future of patients who have suffered disorganising injuries or been subjected to serious operations on the extremities. Recovery from accident or operation does not necessarily imply complete restoration to previous state of health or the prospect of prolonged life.

It need scarcely be said that any ordinary surgical injury to the head, trunk, or limbs may complicate the effects of a concussion of the spine. As has already been stated (Lecture VII.), the usual symptoms of nervous shock arising from spinal concussion are less marked in the majority of those cases in which there is a severe physical lesion elsewhere. But yet instances of this complication are not very unfrequent. I have seen many. There is this important practical point connected with them, that in consequence of the depressed vital power of the limbs—their coldness, the feebleness of the circulation, and the loss of innervation—repair of injury in these cases is far slower than under ordinary circumstances. This is especially the case in the lower extremities. Wounds, even though of a very superficial character, being little more than abrasions, will heal very slowly—months being occupied in the repair of a lesion that would in a strong and healthy person require only weeks.

Thus union of fractures is also delayed, and the callus, when formed, is soft and yielding. In contusions of the limbs the extravasated blood is but slowly absorbed, and the part struck may long continue to be the seat of coldness and neuralgic pain. The vaso-motric actions may be seriously disturbed; the limbs becoming deeply congested, cold and œdematous. This state of things may last for many months, and may possibly in some instances be dependent on deep-seated venous embolism.

LECTURE X.

IMPAIRMENT OF VISION COMPLICATING INJURIES OF THE NERVOUS SYSTEM.

THE eye often suffers from injuries of the nervous system. It may suffer primarily by the same violence that affects the head or spine, or it may be secondarily affected in two distinct ways; either by injury to its delicate organisation, direct or indirect, or by some reflex action dependent on the disturbance of the action of the nervous system, spinal or ganglionic. The various affections of the eye that may thus be developed are all necessarily accompanied by more or less impairment of vision, or even by its complete loss. This is the sign by which the damage to the eye is usually at once recognised, and it is this impairment that constitutes the great importance of injuries of the eyeball.

These various injuries will therefore be considered as giving rise to this particular symptom or effect; and we shall proceed to study 'impairment of vision' as it arises from the following nervous lesions.

1. Concussion of the eyeball, and direct shock to the optic nerve.
2. Injury of the face, implicating the branches of the fifth nerve.
3. Injury of the spinal cord.
4. Injury of the sympathetic nervous system.

1. *Concussion of Eyeball.*—The impairment of vision that arises from simple concussion of the eyeball occurs immediately on the receipt of the injury. It is at its worst at the moment of the occurrence, and may either slowly disappear or become permanent, in consequence of the ultimate development of secondary changes in the structure of the globe, by which complete destruction of vision may ultimately be produced, either by changes taking place in the retina or choroid, or by the development of cataract.

This concussion of the globe may be produced in two ways. 1. By a direct blow upon it. 2. By a blow on the head or face, but not actually on the eyeball itself.

A smart direct blow on the eyeball may at once paralyse the retina without giving rise to any organic mischief, laceration of tissue, or effusion of blood in the eyeball itself. In this way it illustrates forcibly and resembles closely the effect of a blow on the head that occasions concussion of the brain without organic injury of the cerebral substance.

The following case illustrates such an injury and its effects.

A gentleman about 30 years of age, in full health and vigour, whilst in a booth at Ascot Races was struck full in the right eye by the cork of a champagne bottle. He felt faint, sick, and was slightly collapsed. He immediately lost the sight of the eye struck. He came up to London at once. I saw him the same evening, about four hours after the

accident. He was still faint and suffering from nervous depression. On examining the eye the pupil was found to be widely dilated, so that the iris formed a very narrow linear circle round it, slightly broader towards the inner than the outer side. All power of distinct vision was lost, but the patient could distinguish the light. The dilated pupil was quite immovable. The pupil of the uninjured eye acted well as soon as the shock was recovered from. I ordered rest in a darkened room; cold evaporating lotions to the eye; purges; moderate diet.

Mr. Critchett co-operated with me in the management of the case. He made a very careful ophthalmoscopic examination, but could detect no sign of internal injury, or of extravasation into the globe. After a time Calabar bean was applied to the eye, and the pupil, after continuing dilated for some weeks, began slowly to contract, vision returning in proportion as it did so.

Here was a case of simple nervous shock to the eyeball, producing paralysis of the optic nervous apparatus, attended in the first instance by evidence of shock to the nervous system, and but slowly and gradually subsiding.

It is a fact well known to all practical surgeons that a blow on the head or face may, without impinging on the eyeball, so severely shake or concuss the globe that the vision becomes seriously and perhaps permanently affected. In these cases the injury done to the eye is mechanical. It is dependent on concussion transmitted through the bones of the head or face to the structures within the orbit.

That such concussion may occasionally be productive of serious injury to the structures of the globe, is evident from the fact that dislocation of the lens has been known to occur as a consequence of such shock, without any direct injury having been inflicted on the eyeball itself.

Dr. D'Eyber (*Gazette Médicale de Paris*, 1840) relates the case of a patient who became affected by cataract in consequence of the wound of the eyebrow by a stone, without any injury to the eye itself. And I have seen cataract developed three or four months after the receipt of a blow on the malar prominence and eyebrow, received in a railway collision by a woman otherwise healthy, about 40 years of age, without any injury having been sustained directly by the eye itself.

In this case, which was seen and most carefully examined by two distinguished ophthalmic surgeons, Messrs. Hancock and Haynes Walton, as well as by myself, it was evident that the concussion which the head generally had sustained had so jarred the lens that its nutrition was interfered with, and a cataractous condition became slowly developed.

If such serious organic mischief can declare itself in the interior of the globe as a consequence of a general jar or shake of the head, it is not unreasonable to suppose that in many of those cases that we witness, in which, after a general shock to the system, obscuration and impairment of vision gradually manifest themselves, and in which, white atrophy of the optic disc is discovered by ophthalmoscopic examination, the injury to the eye, functional and organic, is due to a shake or jar of its nervous structures, by which their nutrition becomes seriously but slowly impaired, and organic changes become secondarily developed in them.

In this way we can account for cataract developing itself as the result of blows on the eyebrows or cheeks. Branches of the fifth pair of nerves, whether frontal or infra-orbital, becoming implicated and irritated, and the nutrition of the globe being subsequently impaired in a way that will be described in the next section.

2. *From Injuries of the 5th Pair of Nerves.*—But independently of the indirect infliction of shock thus transmitted to the delicate struct-

ures of the eyeball from blows on the surrounding and neighbouring osseous prominences, there is yet another way in which the eye may suffer secondarily from injuries of the face, viz., in consequence of wound or irritation of the branches of the fifth pair of nerves. There are numerous scattered cases proving clearly that wounds of the eyebrow or of the cheek, and even severe contusions of these parts, have been followed by impairment, and eventually, by loss of vision.

This observation dates from the very earliest records of medicine. It is as old as the writings of Hippocrates, who speaks of loss of vision consequent on wounds of the eyebrow, and who makes the very accurate and pertinent observation, that vision is less impaired when the wound is recent, but that it becomes progressively worse as cicatrisation becomes older.

Many of the older writers mention cases illustrative of the loss of vision after injuries of the eyebrow. Fabricius Hildanus and La Motte both relate cases in which blindness followed wounds of the outer angle of the orbit. Morgagni relates, on the authority of Valsalva, the case of the wife of a surgeon who was wounded on the eyelid by the spur of a cock. Vision was immediately lost, but eventually recovered by the use of friction over the infra-orbital nerve. This was probably rather a case of concussion of the eyeball than of sympathetic amaurosis. Morgagni relates another case, that of a lady who, in consequence of the upsetting of a carriage, was wounded by some splinters of glass in the upper eyelid. There was no injury to the eyeball, but still vision became gradually impaired, so that by the fortieth day after the accident it was almost completely lost.

Wardrop (*On the Morbid Anatomy of the Human Eye*, vol. ii. p. 194, *et seq.* Lond. 1834) relates several cases in which wounds of the branches of the fifth were followed by loss of vision. Thus, a gentleman received an oblique cut in the forehead, which, from its direction, must have injured the frontal nerve. It was not accompanied by any bad symptoms, and soon healed. But the vision became gradually impaired, and in a few months was completely lost.

A sailor was struck by a ramrod on the eyebrow, where the frontal nerve passes out. Vision was immediately lost and was never regained.

An officer at the siege of Badajoz was struck by a piece of shell on the eyebrow, over the course of the frontal nerve. Vision became gradually imperfect, and in a few months was completely lost.

Wounds of the infra-orbital nerve are also sometimes followed by loss of vision. Wardrop and Beer both mention cases of this kind.

To this category also belong those cases in which the patient becomes amaurotic from irritation of the dental nerves by the crowding of teeth, by pivoting a tooth, by caries, or, as in the case related by Dr. Galezowski (*Arch. gen. de Méd.*) in which a wooden toothpick, broke and lodged in a carious tooth, produced amaurosis, which was cured by the extraction of the tooth. I have seen amaurosis follow the extraction of a nasal polypus.

That a simple contusion of the eyebrow, without wound of any kind, may produce amaurosis, is positively stated by Chelius, who says, 'I have seen a case of complete amaurosis occur suddenly eight days after a blow on the region of the eyebrow, though there was not any trace of it on the skin. The pupil was natural and movable, and there was not the slightest pain.' (South's translation of Chelius' *System of Surgery*, vol. i. p. 430.)

Rondeau (*Affections oculaires reflexes*, p. 53; Paris, 1866), relates two cases that illustrate this subject. The first is that of a saddler, who in falling received a wound on the left eyebrow. This wound was

followed by photophobia and lachrymation of the left eye, and without any pain, by gradual loss of vision in it, at the end of three months. The ball became flaccid and atrophied, the sclerotic yellowish in tint, the iris discoloured, and the pupil immovable. Fifteen years afterwards the right eye became similarly affected, and in eight or ten months he became completely blind.

The second case related by Rondeau is that of a bathman, who was wounded on the left eyebrow by some fragments of broken porcelain. The resulting cicatrix became the seat of continued dull aching pains, intermixed with lancinating neuralgic seizures, extending over the left side of the cheek and head. Three weeks after the accident the sight of the left eye began to fail, objects became cloudy and indistinct. This increased, so that in six weeks vision was completely lost. About this time the right eye became affected with photophobia, deep-seated pain, and impairment of vision. On ophthalmoscopic examination of the left eye it was found that the retina was congested, large venous trunks being seen to enter it here and there. The retina had lost its transparency, especially around the central spot, the borders of which all were ill-defined. The general colour of the bottom of the eye had lost its brightness, so that the choroid was partly marked by the prevailing greyish tint. The same appearances were found in the right eye, but to a less marked extent, the retina being brighter and more natural in colour.

From all this it is evident that amaurosis has been frequently observed to follow injuries of the eyebrow and side of the face. It is by no means necessary that a wound should have been inflicted, a simple contusion is sufficient.

Wardrop makes the very important observation (*loc. cit.* p. 193) that it is only when the frontal nerve is wounded or injured, and not divided, that amaurosis takes place. Indeed, in some cases the amaurosis has been cured by making a complete division of the nerve, as Rondeau states was done by Dr. Eller in a case of amaurosis following concussion of the frontal. In fact it appears to be irritation of a branch of the fifth, as in lacerated wounds, in dental caries, and not its clean and complete section, that disposes to amaurosis.

This is in accordance with the view expressed by Brown-Séguard, who states that 'the immediate effects of the section of a nerve, or its absence of action, are very different from those that are observed as the result of its irritation; that is to say, of its morbid action, which gives rise to veritable derangements in the nutrition of the part supplied by it.' (*Journal de Physiologie.*)

The loss of vision may come on instantaneously, as in the case related by Wardrop of the sailor struck by a ramrod on the eyebrow, or after the lapse of a few days, as in the case recorded by Chelius, where the loss of vision came on eight days after a blow on the eyebrow. Or after a longer lapse of time, as in most of the recorded cases. In the great majority of cases the impairment of vision is at first slight, and gradually goes on to complete loss of sight.

The fact then being incontestably established that loss of vision may follow a contusion or wound of the eyebrow or cheek, irritating and injuring one of the branches of the fifth pair of nerves, the question that naturally presents itself is, in what way can the irritation of a distant branch of the trifacial nerve, unaccompanied by any direct injury of the eyeball or of the structures of the orbit, produce instantaneously, or remotely, loss of vision?

Some observers, who have noticed the occurrence of amaurosis after injury to the branches of the fifth nerve, have attributed this to the prop-

agation of irritation along the sheath of the nerve, until it reaches the trunk of the ophthalmic division, whence it extends to the sheath of the optic nerve and to the retina. But there is no evidence of the propagation of such inflammation, and, in any case, this would be an insufficient mode of explaining those cases in which blindness had suddenly supervened.

That the section of the trunk of the fifth nerve produces important changes in the eye is well known to physiologists, and has been incontestably determined of late years by the experiments of Snellen, Schiff, and others. And whether these experiments explain the morbid changes that occur in the eye as a consequence of the section of this nerve by the supposition that 'neuro-paralytic' inflammation is set up in the globe, or that the surface, by losing its sensibility, becomes more liable to the action of external irritants, matters little to the practical surgeon; they at least serve to establish more fully the clinical fact previously ascertained.¹

Wardrop says, 'The distribution of the first branch of the fifth pair, or ophthalmic branch, explains how . . . wounds of the frontal, infra-orbital, and other branches of nerves which form anastomoses with the ophthalmic ganglion, are sometimes followed by amaurosis' (p. 153). And no doubt he is correct; and that it is in this anatomical arrangement that we must find the solution of what is certainly a surgical, or rather a physiological riddle. It is to the intimate connection that exists between the frontal nerve, which is the direct continuation of the ophthalmic division of the fifth with the sympathetic and the ciliary nerves, that we must refer these various morbid phenomena resulting from irritation. Whether this irritation of the frontal exercises an injurious influence by causing a hyperæmic state of the vessels of the retina and iris is doubtful, but the fact, as the result of clinical observation, is certain, that in some cases it is the primary and determining cause of loss of vision.

3. *Impairment of Vision from Spinal Injury.*—One of the most frequent and most troublesome effects of spinal injury is a certain degree of impairment of vision.

This may assume different characters at different periods after the injury, and may come on at any time afterwards. As we have just seen in cases in which amaurosis follows injury of the supra-orbital nerve, so in the instances in which impairment of vision follows spinal injury, some considerable interval often intervenes between the occurrence of the injury and the development of the eye-symptoms. This is by no means necessarily so, but it does often happen, and if in consequence of bodily suffering or weakness the patient be confined to bed, and be not called upon to use his eyes, it may be long before he discovers that his vision is enfeebled. This is particularly apt to be the case, as the atten-

¹ Meynert has described a root of the trigeminus nerve as proceeding from the anterior ganglion of the corpora quadrigemina, which is characterised by containing large vesicular cells. This he regards as the anterior sensory root of the fifth nerve. Merkel, who has examined the subject more recently, has arrived at the same conclusion as Meynert in regard to its origin, but believes that the function of the root is trophic, not sensory. Merkel founds his opinion partly on pathological evidence, which indicates that the trophic disturbances in the eye after injury to the fifth nerve may have a cerebral origin, and partly on physiological experiment. In the rabbit the root, from the quadrigeminal origin of the fifth, does not fuse with the sensory root of the fifth, but runs separately along the median side of this root. In an experiment he made, whilst the sensory root of the fifth was destroyed, this portion was uninjured, and only very transitory trophic disturbance was the result. If these observations be correct, it follows that trophic changes in the eyeball will occur only when the quadrigeminal root of the fifth is affected.

tion of the surgeon may not be directed to the state of the eyes in the first instance, the symptoms being entirely subjective, and there being no external evidence of anything wrong with the eyes.

The first and most frequent symptom that is complained of, is a dimness or weakness of the sight, so that the patient cannot define the outlines of small objects, and cannot see in an obscure light. If he attempt to read, he can define the letters often even of the smallest print for a few seconds or minutes, but they soon run into one another, become obscured and blurred and ill-defined. Glasses do not materially, if at all, improve this condition. There is often in the early stages a certain amount of double vision—usually associated with slight irregularity in the axes of the eyes, scarcely amounting, however, to a squint. This blurring or indistinctness of vision is often more observable with respect to near than to distant objects. After a time the patient usually begins to suffer from irritability of the eyes in addition to the impairment of sight. He cannot bear a strong light, not even that of an ordinary window, in the daytime; he sits with his back turned towards it, or has it shaded. He cannot bear unshaded gas or lamp-light. In consequence of this irritability of the eyes the brows are involuntarily contracted, and the patient acquires a peculiar frown in order to exclude the light as much as possible from the eyes. This intolerance of light may amount to perfect photophobia, and is then associated with a congested state of the conjunctiva, and accompanied by lachrymation.

One or both eyes may be thus affected. Sometimes one eye only is intolerant to light. This intolerance to light is associated with impairment of vision. It is usually accompanied by *muscæ volitantes* and spectre-rings; and stars, spots, flashes, and sparks, white-coloured and flame-like, are also complained of. The appearance of a fixed luminous spectrum—a line, circle, or coloured bar—across the field of vision is sometimes complained of. There is an undue retention of images in many cases, and when the patient has looked at any bright object, the sun or the fire, supplementary spectral colours, often of the most beautiful character, of varying degrees of intensity, will develop themselves in succession. The patient becomes, in some cases, conscious of the circulation in his own eye, which becomes visible to him.

Double vision is frequent with both eyes open. But there may be double or even treble vision with *one* eye. A patient may see two lights, or, perhaps, two lights distinctly and the shadow of a third, with one eye only. This happens independently of injuries to the nervous system, but has often been denied, and I have known a patient stigmatized as an impostor because he said he had double vision with one eye. But I am acquainted with two medical men who suffer from this peculiarity. This double or even treble vision with one eye is now recognised by ophthalmologists as a distinct affection, under the term *polyopia monophthalmica*. I know not the explanation, but of the fact I am certain.

In other cases the patient loses the power of correctly judging of the distance both of near and far objects.

From the description of the various symptoms of the impairment of vision that supervene on spinal injury, it would appear that the failure of sight may arise from one of four conditions, or from a combination of two or more of these. Mr. John Tweedy, who has paid much attention to this important subject, has favoured me with the following lucid explanation of the ocular phenomena attendant on spinal concussion. There is, firstly, *asthenopia*, or simple weakness of sight: the patient is unable to accommodate for near objects for more than a few minutes. Either the nerve-supply to the ciliary muscle is impaired, so that the

muscle soon becomes fatigued and is unable to maintain sufficient tension to keep the crystalline lens properly adjusted, or there is weakness of one or both of the internal recti muscles, and the patient cannot, consequently, keep up due convergence of the eyes—an essential element in the adjustment of the eyes for near objects. Associated with either or both of these may be, secondly, a certain degree of amblyopia, a paresis of the retina or optic nerve. The retina may be capable of receiving for a time accurate impressions, which may be readily transmitted along the optic nerve to the brain, but, sooner or later, a state of exhaustion is induced, a state not unlike the 'pins and needles' experienced in other weakened or injured sensory nerves. Thirdly, the power of accommodation of the eye may be completely lost, the patient being quite unable to read or write, or to see clearly any near object, although the retina and optic nerve may be quite healthy and distant vision normal. It is desirable that this condition should be recognised, as it has an important bearing on prognosis and treatment. For instance, it sometimes happens that a short time after the receipt of an injury to the head or spine a patient finds that he is unable to see to read or write, but that his distant vision remains good. Unless great care be exercised, this condition may be taken as indicative of commencing amaurosis. If, however, a little of the extract of Calabar bean be instilled, tension of the accommodative apparatus is induced, and, for the time, vision for near objects is good, and, may be, normal. If there be in addition to the paralysis of accommodation some anomaly of refraction, hypermetropia, myopia, or astigmatism separately or conjoined, matters are still worse. If hypermetropia exist, the distant vision will also be impaired when the power of accommodation is lost, for then even parallel rays of light are not sufficiently converged to come to a focus on the retina, and circles of diffusion are formed. If astigmatism be present, the optical inconveniences with which this condition is always attended are greatly increased by failure of accommodation. If, then, any of these anomalies exist, properly selected spectacles will be necessary to enable the patient to see accurately even distant objects. It must not, however, be forgotten that the loss of power of accommodation is always of grave significance, and may be the forerunner of serious nutrition changes in the deeper structures of the eye, changes which may eventuate in blindness. Fourthly, there may be irritability of the eye and photopsia depending on hyperæmia of the retina, or on inflammation of it and of the optic nerve. In ordinary erethitic amblyopia the symptoms are not constant, but vary in intensity at different periods of the day, being usually worst in the morning. They vary also with the state of health and with the condition of the mind, being less marked when the health improves and when the patient is in good spirits. They are, moreover, influenced by the state of the weather and surrounding circumstances, everything of a depressing character having a tendency to aggravate the symptoms.

The objective appearances presented by the eye, and the ophthalmoscopic manifestations seen in the interior of the globe in these cases, have been carefully studied by Mr. Wharton Jones and Dr. Clifford Allbutt.

Mr. W. Jones, in his admirable and scientific work 'On Failure of Sight after Railway and other Injuries,' states that the pupils are usually half closed, the eyes sunken, dull and watery, the veins of the eyeball congested. The movements of the pupils are sometimes normal, sometimes sluggish, but sometimes more active than usual. This will necessarily depend upon whether the eye is affected by simple asthenopia, or whether there is some hyperæmic or inflammatory state already developed in its interior.

The ophthalmoscopic appearances were found to vary greatly. In some cases, as Mr. Wharton Jones most justly observes, the morbid state on which the failure of sight and other subjective symptoms depend, may be at first confined to some central portions of the optic nervous apparatus, and no ophthalmoscopic evidence of implication of the retina or optic disc may present itself till a more advanced stage of the case. Sooner or later, however, whether as the effect of primary changes in the fundus, or as the result of a slowly progressive inflammatory affection propagating itself from the intra-cranial portion of the nervous apparatus towards its periphery, and thus inducing morbid changes in the optic nerve and disc, we find that the ophthalmoscope reveals changes in the fundus of the eye. 'The disc is seen to be whitish, and somewhat congested; the retinal veins are large, though the fundus usually presents an anæmic aspect, with perhaps some pigmentous degeneration of the retina round the disc' (p. 44).

Dr. Allbutt, who has investigated this subject with great care and acumen, and in a truly scientific spirit, furnishes the following detailed and accurate account of the appearances presented in these cases, which I prefer giving in his own words:—

'Having seen, then, that there are changes in the eye symptomatic of spinal diseases, our second inquiry is, Of what kind are these changes? Confining ourselves to the optic nerve and the retina with their vessels, and omitting all reference to injection of the conjunctiva, or the state of the pupil, what kind of changes are dependent upon disturbance of the spine? I find that they may be well classified under two heads:—1. Simple or primary atrophy of the optic nerve, sometimes accompanied at first by that slight hyperæmia and inactive proliferation which make up the state I have called chronic neuritis. This sort of change I have never found as a result of spinal injuries, but I have often met with it in chronic degeneration of the cord and in locomotor ataxy. 2. A somewhat characteristic hyperæmic change which I have not seen in chronic degeneration or in locomotor ataxy, but in cases of injury to the spine only. The retinal arteries do not dilate, but become indistinguishable; while the veins begin to swell and become somewhat dark and tortuous. The disc then becomes uniformly reddened, and its borders are lost, the redness or pinkness commencing with increased fine vascularity at the inner border, and which thence invades the white centre and the rest, so that the disc is obscured or its situation known only by the convergence of the vessels. In many cases, rather than redness, I have observed a delicate pink—pink which sometimes passes into a daffodil colour. In one case in particular—a railway accident—which I examined in consultation with my friend and colleague, Mr. Teale, this daffodil colour of the whole field was very curious; no disc was to be distinguished, but the dark vessels stood out in beautiful relief. The other eye presented the more common appearances of hyperæmia and serous effusion, with slight swelling. It is to be remarked that this state is generally or always of long duration; it passes very slowly up to its full development, and then shows a disposition to end in resolution rather than in atrophy. In those cases which I have been able to watch diligently for many months the pinkness seems slowly to have receded, leaving an indistinct but not very abnormal disc behind. Sometimes the sight suffers a good deal in these cases, sometimes but little or scarcely at all. I have never seen true optic neuritis with active proliferation as a sequel of spinal disease.'—*Lancet*, 1870, vol. i. p. 76-77.

One or other of these conditions occur in the majority of cases of spinal injury, such as we are describing in this work. Dr. Allbutt says, 'It is tolerably certain that disturbance of the optic-disc and its neigh-

bourhood is seen to follow disturbance of the spine with sufficient frequency and uniformity to establish the probability of a casual relation between the two events.' Dr. Allbutt goes on to say that of thirteen cases of chronic spinal disease following accidents, he found eight cases of sympathetic disorder of the eye.

My experience fully accords with that of Dr. Allbutt. I find that in the vast majority of cases of spinal concussion unattended by fracture or dislocation of the vertebral column, there occurred after a few weeks distinct evidence of impairment of vision.

Dr. Allbutt, in the very important practical communication to which I have referred, makes the interesting remark, which will be supported by the experience of all surgeons, that in the severer forms of spinal injury, those that prove fatal in a few weeks, these evidences of eye disease are not met with; for out of seventeen such cases he found no evidence of eye disease in any one instance. This is a most important observation, and one that bears strongly on the cause of these affections. It also affords a most complete answer to an objection that has often been urged in these cases, viz., that as sympathetic affection of the eye is rarely met with in severe injuries of the spine, such as fractures and displacement of the vertebrae, with transverse lesion of the cord, its occurrence in the less severe and more obscure forms of injury can scarcely be looked upon as the direct result of the spinal mischief. It would appear, however, from the observations of Dr. Allbutt, which I can entirely confirm, that it is in these very cases that it is met with, and not in the severe and rapidly fatal ones.

That a certain portion of the spinal cord exercises a direct influence on the eyes, has been incontestably established by the experiments of modern physiologists. It has been long known that the upper cervical portion of the spinal cord and its intra-cranial prolongation control the movements of respiration, and hence it is well known to physiologists as the 'respiratory tract'—so also the lower dorsal and lumbar divisions exercise an influence on the genito-urinary apparatus, and are known as the 'genito-spinal.' But it has been reserved for the more modern researches of Budge and Waller, who in 1851 demonstrated that the filaments of the sympathetic that supply the eye take their origin from that part of the spinal cord which is contiguous to the origin of the first pair of dorsal nerves, and that the portion of the spinal axis which extends from the fifth cervical to the sixth dorsal vertebra, and according to Brown-Séguard, even as far as the tenth dorsal, possesses a distinct influence on the organs of vision. Hence, by these physiologists it has been termed the '*cilio-spinal*,' and by Claude Bernard the '*oculo-spinal*,' axis.¹

It has been determined, as the result of numerous experiments by these physiologists, that the partial division of this cilio-spinal axis occasions various disturbing influences on the size of the pupil, the vascularisation of the conjunctiva, and probably of the deeper ocular tissues, and on the state of the blood-vessels of the ear, exactly similar to those that are occasioned by the section of the cervical sympathetic. The conclusion that must necessarily be deduced from these observations is, that this portion of the spinal cord—the *oculo-spinal axis*—includes within itself both vaso-motor and oculo-pupillary filaments which are connected with the cervical portion of the sympathetic.

Claude Bernard has pointed out clearly the fact that the vaso-motor and the oculo-pupillary nerves possess different reflex actions. By di-

¹ Rondeau, *Affections oculaires reflexes*, p. 22, *et seq.*

viding the two first dorso-spinal roots he finds that the oculo-pupillar phenomena are produced without occasioning the vaso-motor effects in vascular injection and increase of temperature. Whereas, by dividing the ascending sympathetic filament between the second and third rib, the vaso-motor phenomena are developed in the head without any influence being exerted on the eye through the medium of the oculo-pupillary filament. He sums up his observations as follows: 'The vaso-motor and the oculo-pupillary nerves do not act in the same way. . . . Thus, a slight irritation of the auricular nerve only occasions vascularisation in the corresponding side, whilst the same irritation produces reflex movements in both eyes at the same time. The reflex vascular actions do not appear to be capable of being produced on the opposite side to that which is irritated (*d'une manière croisée*), and besides this they are limited and do not extend beyond a certain determined line of circumscription. All this is in striking contrast with the oculo-pupillary actions which are, on the contrary, general and crossed.'—Rondeau, *op. cit.* p. 24.

These physiological observations have an important practical bearing on affections of the eye and loss of vision consequent on injuries of the spine.

Clinical observations support the results of physiological experiment in the connection that subsists between the oculo-spinal axis of the cord and the integrity of vision. Thus—without going so far back as the account that Plutarch gives of the injury sustained by Alexander the Great, who was in danger of losing his sight from the effect of a blow inflicted by a heavy stone on the back of the neck—the records of surgery contain numerous illustrations of the injurious influence of blows on the sight—of blows inflicted on the lower cervical and upper dorsal spine. Thus Rondeau relates that he saw the following case at an asylum for the blind: A lad aged 17 fell, when five years of age, down a staircase, striking the shoulder and the back of the neck against the edge of the steps. He did not lose consciousness, but some days afterwards he became quite blind. Under treatment his sight gradually returned, so that at the end of a month he could distinguish the light, and in the course of four years he could discern objects placed near to him. Beyond this no improvement took place, and when Rondeau saw him he found the pupils dilated and the optic disc in a state of white atrophy, more marked towards the centre than at the circumference.

The influence on vision of blows and injuries of that part of the spine situated at the root of the neck and between the shoulders, is well illustrated by many of the cases narrated in this work, and explains the statement made by Dr. Allbutt, of Leeds, in his interesting and important observations to which reference has already been made at p. 116, that those injuries and concussions of the spine that occur high up are more injurious to vision than such as are inflicted on the lower portion of the vertebral column.

To what is this impairment of vision due? Dr. Allbutt, who has studied the subject with much care, gives his opinion, in which I fully coincide, so clearly that I cannot do better than quote his own words:—'In default of a series of autopsies, we seem to be led towards the conjecture that hyperæmia of the back of the eye, following injury to the spine, is probably dependent upon a greater or less extension of the meningeal irritation up to the base of the brain. Now, have we any reason to suppose that spinal meningitis does creep up into the encephalon? We have: for, setting aside the curious head symptoms such patients often present, here the actual demonstration of autopsy comes to aid us. It is tolerably well known to careful pathologists that encephalic menin-

gitis is a very common accompaniment of spinal meningitis. It is scarcely needful to point out that if this explanation of an ascending meningitis be the correct one, it accords with my observation, stated above, that, in general, the higher the injury to the spine the sooner the affection of the eye.'

In chronic spinal meningitis, more especially in the upper part, there may be found a hyperæmic state of the fundus, due to the extension upwards and along the base of the brain of the inflammation of the meninges. 'These optic lesions,' says Dr. Long Fox, 'are due solely to the creeping upwards of a meningitis that was originally spinal, but ends in being cerebral.'—*Path. Anat. of Nervous System*, p. 398.

4. *Impairment of Vision from affection of the Sympathetic.*—Mr. Wharton Jones,¹ who has investigated the influence of the sympathetic in a truly philosophic spirit, states that an affection of the sight in the form of perverted, impaired, or lost sensibility of the optic nervous apparatus, is liable to supervene, in a longer or shorter time, on concussion of the spinal cord or brain. The symptoms, as a rule, come on insidiously, and do not attain any degree of prominence until a considerable time after the accident—may be many months. At first they are transitory and subjective in character, and consist of asthenopia, luminous spectra, rings, stars, and flashes of light, scotomata, photophobia, impaired power of adjustment, undue retention of images, failure of power to estimate distance and position (and to coördinate voluntary movements), diplopia. The size of pupil varies, it may be in the middle state, or contracted, or more rarely dilated, and its action may be sluggish or unduly active. After these transitory symptoms have existed for some time, the vision gradually deteriorates and finally becomes amaurotic. The ophthalmoscopic appearances that are to be observed in eyes that are undergoing the changes which eventuate in blindness, are, according to Mr. Jones, in the early stages, 'increased vascularity with some whiteness of the optic disc; congestion of the retina; blackish discolouration of the retina adjacent to the disc; pigmentous deposit in the disc itself.' Ultimately, the optic nerve becomes atrophic and white. In some cases, however, of failing sight after injuries to the spine or head, no ophthalmoscopic evidence may declare itself for a considerable time. If the injury be inflicted on some part of the 'optic nervous apparatus' behind the eye, as, for instance, in the corpora quadrigemina, the tractus optici, the commissure or orbital part of the optic nerve, the sight may be greatly impaired or actually destroyed long before there are any appreciable ophthalmoscopic manifestations of the morbid changes. Atrophy of the optic nerve is generally the final stage, but that form of atrophy which supervenes on spinal injury is a result of optic neuritis, and does not attain so complete development as the white atrophy of cerebral amaurosis.

The amaurotic affections depend on nutritive changes, as congestion, hyperæmia, anæmia, inflammation, and its consequences, leading to degeneration of structure and nervous exhaustion in some portion of the optic nervous apparatus. If the seat of the morbid processes be in the retina, impressions are not received, if in the optic nerve or tract they are not transmitted, and if in that part of the brain with which the optic nerve is connected, the sensorial power to take cognisance of the transmitted impressions is lost. But whatever part sustains the primary injury, the ultimate result is the same; the affection of one part leads to the degeneration of the whole, and white atrophy of the

¹ *Failure of Sight from Railway and other Injuries of the Spine and Head*: 1869; a most able and philosophic work.

optic disc and atrophy of the intra-cranial portion of the optic nervous apparatus ensue.

To explain and account for the changes, Mr. Wharton Jones has brought together a large amount of physiological knowledge, and arguing from the experimental and pathological evidence of the influence which the sympathetic nerves exert on the arterial system, has inferred that the failure of sight after injury to the spinal cord, where the brain is apparently unaffected, is due to the transmission of the morbid action from the cord to the bloodvessels of the optic nervous apparatus by the sympathetic nerves rather than to the extension of the inflammatory and degenerative changes from the spinal cord to the brain. In support of this position Mr. Jones describes in detail the experimental effects on the nutrition of certain areas produced by irritation or section of the sympathetic nerves supplying the bloodvessels of these parts; and compares the effects of spinal injury on the sight with those of locomotor ataxy. He, moreover, enters into a minute description of the origin and distribution of the sympathetic nerves, supplying the bloodvessels which go to supply the brain and the organs of sight and hearing. He points out that the sympathetic nerve of the neck was first shown by Dr. Brown-Séguard¹ to have its roots in that part of the spinal cord which extends from the sixth cervical to the ninth or tenth dorsal vertebra. Then Wutzer² stated that the sympathetic derives radicle fibres from both roots of the spinal nerves, while Mayer³ traced these fibres in the roots to the spinal cord itself. Arguing from Professor Budge's⁴ experiments, it is affirmed that of these fibrils some of them are centrifugal or motor, and pass through the anterior roots, while some are centripetal or excitator, and pass through the posterior roots to the ganglion cells, which lie near the centre of the grey substance of the cord, between the cells of the anterior roots and the cells of the posterior roots. From this origin the fibrils pass through rami-communicantes of the corresponding spinal nerves to join the sympathetic in the neck, and thence to enter the cranium in the internal carotid and vertebral plexus. The exact distribution of the nerve is as follows: Some of the anterior branches of the superior cervical ganglion form the external carotid plexus; the internal carotid plexus is formed by the ascending branches of the superior cervical ganglion, which gives off filaments to the walls of the branches of this artery, and among others, to the ophthalmic artery. From this plexus, also, is derived a filament which joins the ophthalmic division of the fifth nerve in the cavernous sinus, and then enters the orbit. The nasal branch, which contains many of these filaments, gives off the long root of the lenticular ganglion, and a few ciliary nerves, the majority of the ciliary nerves being derived from the lenticular ganglion. The middle root of the ganglion is also a filament of the carotid plexus, while the short root is derived from the lower branch of the oculo-motor nerve. The ciliary nerves then accompany the ciliary arteries into the eyeball, and the arteria centralis retinæ is accompanied by a minute branch from the lenticular ganglion. The fibrils of the oculo-motor nerve which the ciliary nerves derive from the short root of the ganglion govern the contractions of the muscular fibres of the sphincter pupillæ, while the sympathetic fibrils govern the contraction of the muscular walls of the arteries and of the radiating fibres of the dilator pupillæ.

¹ *Sur les Résultats de la Section et de la Galvanisation du Nerf Grand Sympathetic au Cou.* In *Gazette Médicale de Paris*, 1854.

² Müller's *Archiv*, 1834, p. 306.

³ *Nova Acta*, xvi. p. 2.

⁴ *Ueber die Bewegung der Iris.* Für *Physiologen und Aerzte*. Braunschweig, 1855.

By the aid of this knowledge of the distribution of the sympathetic of the neck, the phenomena of irritation or division of the nerve may, Mr. Jones affirms, be explained. Experiments have shown that division of the sympathetic nerve in the neck is followed by heat and vascular fullness in the corresponding side of the head; the ear becomes dark-red; the conjunctiva and nasal mucous membrane turgidly injected, and the pupil contracted. The same effects follow when the spinal cord is experimented on between the sixth cervical and the ninth or tenth dorsal vertebra.

On the other hand, irritation of the sympathetic nerve above the section of that portion of the spinal cord just referred to, produces coldness and pallor of those parts, by constricting the arteries, and dilatation of the pupil. The alterations in the size of the arteries are associated with corresponding changes in the nutrition and vital energy of the affected part. When the vessels are constricted through irritation of the sympathetic nerve, the circulation is retarded, the nutrition impaired, the heat lessened, and the vital energy diminished. Whereas, destruction of the sympathetic is followed by dilatation of the arteries, and a fuller and free flow of blood through them; and in some cases actual inflammation may result. When the sympathetic nerve in the neck or the spinal cord, lying between the sixth cervical and tenth dorsal vertebrae, is morbidly affected, nutritive changes, with corresponding symptoms, declare themselves. When, for instance, the sympathetic in the neck is irritated as a result of disease or injury of the spinal cord, the arteries supplying the optic nervous apparatus are constricted, and there is temporary impairment of vision. But when the nerve is destroyed, the early symptoms are usually photophobia, photopsia, &c. By and by these transient changes in the circulation of the optic nervous apparatus become persistent, and a low form of inflammation results. Other observers have explained the pathology of this inflammation in a different manner. According to some, the inflammation starts in the central portion of the optic nerve, and is directly transmitted along the nerve; or the intra-cranial mischief may manifest itself through the disturbed circulation in the retinal vessels within the eye, under the form of venous congestion and swelling of the optic disc. But Mr. Jones maintains that there are instances in which hyperæmia, congestion, and even actual inflammation of the optic nerve occur without there being any evidence of intra-cranial disease. Von Graefe, as is well known, believed that the venous congestion of the optic disc was the result of the incarcerating action of the sclerotic ring, while Dr. Clifford Allbutt supposed that pressure on the cavernous sinus acted as an auxiliary by preventing the return of venous blood from the eye. But Mr. Jones thinks that the contraction of the arteries, and the accumulation and stagnation of the blood in the capillaries and venous radicles, may be accounted for by irritation of the sympathetic nerve in the neck, or by irritation of the spinal cord in the cervico-dorsal region. When the sympathetic in the neck, or the cervico-dorsal portion of the spinal cord is irritated, in addition to the changes in the circulation of blood in the optic nervous apparatus, the pupil becomes more or less dilated; but when the nerve is actually destroyed, the pupil is contracted.

When the head itself has been injured, amaurosis may, according to Mr. Jones, follow as a result of actual injury to the optic nervous apparatus, of the pressure of extravasated blood, or, thirdly, of inflammation of the optic nerve, as a sequence of basilar meningitis. Here again failure of sight may precede any ophthalmoscopic evidence.

LECTURE XI.

ON CERTAIN FORMS OF PARALYSIS OF THE LIMBS FROM LOCAL INJURIES WHICH MAY COMPLICATE CONCUSSION OF THE SPINE.

WOUNDS of nerves, incised or gunshot, necessarily lead to the paralysis of the parts supplied by the injured trunk. The consideration of such injuries is altogether foreign to this work, and you will find it treated in an exhaustive manner by Dr. Mitchell, of Philadelphia, in a special treatise on this subject.¹

There are, however, lesions of nerves of a somewhat obscure character, arising from their compression, concussion, or strain, to which I may briefly direct your attention, as coming within the scope of these Lectures.

The nerves are less frequently injured by accidents affecting the limbs than would at first appear probable. This is in great measure owing to their escaping ordinary blows and strains by being situated on the most protected side of the limb, and by the tendency they have, in consequence of the laxity of their connections, to fall away from the part struck, and thus to escape injury.

When compressed or concussed, the immediate symptoms consist of tinglings and numbness along the courses of the nerve, usually of a transitory character. If the pressure is more continuous, it becomes a common cause of temporary paralysis. A familiar illustration of this is afforded by the partial paralysis both of sensation and motion that often affects the hands of persons who lean long and heavily on crutches, and by that means compress the axillary plexus.

The same kind of paralysis may occur in some forms of spinal injury, especially in strains of the vertebral column, in consequence of which the nerve-trunks become compressed near their origins, or as they escape through the foramina, by effusions, whether of blood or inflammatory exudations.

The nerves that are most frequently injured by these concussions, contusions, or compressions are the sciatic and its branches in the lower, and the circumflex, ulnar, and musculo-spiral in the upper extremities. I have so frequently spoken in these Lectures of the various forms of paralysis of the lower extremities resulting from injury to the nerves of the lumbo-sacral plexus generally, and more especially to the sciatic, that I need say nothing about them here. But I shall confine myself to the consideration of certain forms of paralysis of the upper extremities, which arise from injury to special nerves of the brachial plexus, either from injury of the cord in the cervical region, or of the nerve-trunks themselves in their course down the limb. The supra-scapular, the circumflex, and the musculo-spiral nerves are those that are most liable to injury.

The *supra-scapular* nerve may be injured by direct violence applied to the back of the scapula. A most marked instance of this form of injury, leading to paralysis and acute atrophy of the supra- and infra-spinatus muscles, occurred in the case of a young man who came under

¹ *Injuries of Nerves and their Consequences*, by J. Weir Mitchell, M.D., Philadelphia, 1872.

my care at University College Hospital for an injury of the right shoulder occasioned, he said, by the running away of a horse which he was driving. In order to pull it in he twisted the rein round his right hand, but the horse overpowering him, he felt acute pain in the shoulder, which gradually became powerless. On examination, the supra- and infra-spinatus muscles were found to be completely atrophied, so as to leave deep hollows above and below the spine of the scapula. The atrophied remains, if, indeed, any existed, of the muscles were insusceptible to the electric current, and the deltoid was partially wasted. In this case it would appear that the supra-scapular nerve had been overstrained—had become paralysed, and that acute atrophy of the muscles supplied by it had ensued.

Paralysis of the deltoid from injury to the *circumflex* nerve of the arm is by no means uncommon. This condition usually happens from falls on the shoulder, and direct concussion of the nerve. In it the deltoid gradually wastes, so that the acromion becomes prominent. In consequence of this atrophy the arm cannot be raised from the side, or, if raised, it cannot be maintained in the extended position. The natural support of the arm by one of its capsular muscles being lost, the shoulder not only loses its rotundity in consequence of the loss of power in the *deltoid*, but the arm drops, and then the withered deltoid becomes drawn down, and thus the flattening of the shoulder is increased. The acromion appears to project; a hollow into which the tips of the fingers can be insinuated is formed under it, and the head of the bone is drawn somewhat forwards by the action of the pectoralis major. Thus there is produced a remarkable simulation of a partial dislocation of the head of the bone inwards, and indeed some secondary displacement often occurs in this direction, which requires to be corrected under chloroform before faradisation and general tonic treatment, with the view of restoring power to the nerves and tone to the muscles, can be employed with success.

The *musculo-spiral* is the nerve the paralysis of which leads to the most serious consequences. This condition may arise from injury to the cervical spine or to the trunk of the nerve.

In Case 31 you will find an instance of its paralysis from spinal injury. I will now relate several cases of a previously undescribed form of paralysis from fractures of the humerus.¹

Simple fractures of the long bones are seldom accompanied by any serious complications; the vessels and nerves of the limbs being so situated, and being so well protected by the interposition of a layer of muscle between them and the bones, as to escape being injured, in the vast majority of cases, by the ends of the fractured fragments. There are, however, two exceptions to this general rule: one in the upper, the other in the lower, extremity. In the upper extremity, in the relation of the musculo-spiral nerve to the shaft of the humerus; in the lower, in the position of the posterior tibial artery in reference to the upper end of the tibia. In both these instances the position of the nerve and of the vessel is such that they may be seriously injured by fracture of the contiguous long bones.

The complication of an injury of the musculo-spiral nerve, in a case of simple fracture of the humerus, must certainly be of rare occurrence, as I find no mention made of it in the standard works on surgery that I have had an opportunity of consulting, and I do not recollect to have met with this accident until recently. I have, however, had lately three cases under my care at the hospital, in which, in consequence of injury

¹ *Lancet*, July 1, 1871.

to the musculo-spiral nerve or one of its branches, more or less complete paralysis of the muscles supplied by that nerve resulted. These cases I will presently relate to you, and on them I will found the observations I have to make on this interesting subject.

When we observe the manner in which the musculo-spiral nerve winds closely round the back of the shaft of the humerus in its flattened groove, and how in its course downwards towards the forearm it comes into tolerably close relations to the outer condyle, we can easily understand how in fractures of the shaft of the bone the main trunk may be implicated, and in those of the condyle one or other of its chief divisions injured.

When the main trunk of the musculo-spiral nerve is injured to such an extent as to induce complete paralysis of it, both the supinators of the forearm and all the extensors of the wrist and fingers lose their power, and the patient becomes utterly incapable of performing those movements that are dependent on the action of these muscles. The hand consequently falls into a state of pronation and flexion, presenting the characteristic signs of 'wrist-drop.'

When the posterior interosseous division of the musculo spiral is the nerve that is injured, the loss of supination and of extension is not so complete. The supinator longus and extensor carpi radialis longior muscles, being supplied by branches from the main trunk, are not paralysed, and thus a certain though very limited movement of supination and extension is preserved, although the forearm and hand fall naturally into a state of pronation and flexion.

These different conditions were well illustrated in the following three cases, which I will relate to you in the order of their degrees of extent and severity, so far as regards the paralysis of the various sets of muscles. An attentive study of the movements of the wrist, hand, and fingers in these cases throws a clear light on the actions of the muscles supplied by the musculo-spiral nerve and its branches, and some of the other nerves of the forearm and hand.

Case 51. Fracture of Shaft of Humerus—Paralysis of Trunk of Musculo-spiral Nerve, and complete Loss of Extension of the Wrist, Fingers, and Thumb—Loss, nearly complete, of Supination.—E. L., aged 29, by occupation an ironer, admitted December 16, 1870. Ten weeks before the patient fell and fractured her humerus about the middle. She was treated as an out-patient, and the limb put upon an angular splint, so as to fix the elbow-joint. When the splint was left off, at the end of four weeks, she was directed not to use her arm for a week. She noticed wrist-drop when she took off the splint, but thought it was mere weakness. At the end of a week, however, on trying to use her hand, she found that she had no power in the wrist or fingers. It was thought to be weakness, and she bathed it with cold water. The hand had for some time felt much colder than the other. On examination it was found that there was marked wrist-drop, with pronation. She could not extend the hand at all. The right forearm, hand, and fingers were swollen. She felt a difference in the temperature of the two hands, but not so great as formerly. Occasionally she had a feeling of pins and needles all down the hand and fingers. The thumb and index-finger, especially the former, were numb on the dorsal aspect. Sensation over them was imperfect. Flexion of the fingers was imperfect owing to stiffness of the knuckles. The temperature of the affected hand did not raise the index of the clinical thermometer to 85°; that of the other was 90·6°. All the muscles supplied by the musculo-spiral nerve were paralysed completely. She had consequently totally lost all power of extending the wrist. She had no

power of extending the thumb. She had no power of extending the fingers from the metacarpo-phalangeal joints; but when the fingers were completely flexed she could extend the joints between the first and second and second and third phalanges. This was evidently accomplished by means of the interossei and lumbricales muscles, which are attached to the expansion of the extensor tendons on the dorsum of the fingers lower down than the metacarpo-phalangeal joints. On holding the index-finger forcibly down, and telling her to try to extend it, the thumb was drawn in towards the palm by the attachment of the first dorsal interosseous to the metacarpal bone of the thumb. Supination could be performed apparently in a very feeble and imperfect manner, but only when the forearm was flexed. Flexion of wrist, hand, and fingers was perfect.

After this she was galvanised by faradisation regularly, and regained considerable power in all the affected muscles, so that she could extend the wrist and the fingers from their metacarpo-phalangeal articulations.

There are several points in this case that deserve special attention. That the trunk of the musculo-spiral nerve was paralysed by being implicated in the fracture which occurred in that part of the humerus round which it winds, there can be no doubt. All the muscles connected with the hand and wrist that are supplied by both the terminal divisions of that nerve—the radial and the posterior interosseous—were paralysed, and none other were affected.

Now let us examine a little more in detail the conditions of the hand and fingers. The wrist-joint was flexed, so that the hand hung listless and inactive, at nearly right angles with the forearm. It could not be raised or extended in the slightest degree. No effort that the patient made in this direction was of any avail. There was, consequently, complete paralysis of the two extensors of the wrist—the long and the short. The hand was prone; complete supination was impossible, and no movement whatever in that direction could take place when the forearm was extended on the arm. But when the forearm was flexed, a slight supine movement could be made by the patient. To what was this due? Clearly not to the supinators, which would have acted equally well whatever the position of the elbow might have been. But apparently the slight effort at supination, for it was really nothing more, was the result of contraction of the biceps, which, as you are aware, when called into action whilst the hand is prone, has for its first effect a tendency to supinate the forearm and hand. There was, consequently, complete paralysis of the two true supinators—the long and the short. Thus there must have been loss of innervation in both the terminal branches of the musculo-spiral—the radial and the posterior interosseous. The long extensor of the fingers was paralysed, so that they hung at right angles with the hand, they could not possibly be extended from the metacarpo-phalangeal articulations so as to be brought to a level with the dorsum of the hand. But there was one movement of extension still left to the fingers, and it was this—that when they were bent or drawn into the palm of the hand, the last two phalanges could be extended, and with some little force, from the articulations between the first and second phalanges. Now this is an extremely interesting point, and one to which I would direct your close attention. To what is this upward or extending movement of the two terminal phalanges due?—a movement that takes place independently of the action of the true extensors of the fingers. It is due to the combined action of the interossei and lumbricales—muscles that do not receive their innervation from the musculo-spiral, but chiefly from the deep branch of the ulnar; all the interossei and the two innermost lumbricales receiving

their nerves from this source, whilst the two outermost of the lumbricales obtain theirs from the median nerve. Thus these accessory muscles of extension, receiving their nervous supply from sources that were uninjured, continued in the free exercise of their special actions. The thumb was drawn in towards the palm, and could not be abducted owing to the paralysis of the extensor muscle of the metacarpal bone. The numbness and referred sensations occupied those portions of integument that were supplied by the terminal branches of the radial nerve. The temperature of the hand was considerably lower than the other. It was below the lowest mark (85° F.) on the clinical thermometer; and as that of the sound hand was 90·6, there must have been a difference of at least 5° to 6° F. between the two limbs.

The next case that I will relate to you is one in which the paralysis seems to have been limited to the posterior interosseous nerve. It is as follows:—

Case 52. Wrist-drop following Compound Fracture of the External Condyle of the Humerus—Paralysis confined to the muscles supplied by the posterior interosseous nerve.—H. E., aged 30, by occupation a lace-cleaner, on November 17, 1870, slipped down on her right elbow on the pavement, and afterwards came to the hospital. On examining the elbow, much mobility and crepitus were found, and a fracture of both condyles, with separation, could be clearly made out. At the back of the arm, about an inch above the elbow, was a wound which would take the tip of the little finger, clean cut without bruising of the edges, apparently done by protrusion of the bone at the time of the fall. A probe could pass in different directions readily among the tissues. From Nov. 17 till Dec. 21 the limb was kept on an angular splint at the inner side, and the wound treated in strict accordance with Lister's rules for antiseptic dressing. On Nov. 24 (eighth day) there was much swelling, with some redness and tension, about the joint and upper half of the forearm. It was thought that fluctuation existed; and an incision, about three quarters of an inch long, was made below the elbow. Much serous fluid came, but no pus. Large quantities of serous fluid continued to come from the wound for a fortnight afterwards. The tension rapidly disappeared; no pus was at any time observed. Passive motion was commenced on Dec. 21. The splint was left off on Dec. 23. There was much stiffness of the joint.

Jan. 23rd.—Patient can bend the elbow to an angle of 45°; can straighten it to about a right angle and a half. Can close the hand as far as to bring the tips of the fingers to about an inch from the palm; her hand can be made to close completely without much difficulty. There is perfect flexing and opposing power in the thumb. When the hand and forearm are supinated the wrist is quite straight. Cannot completely straighten the hand at the metacarpo-phalangeal joint. Very slight force brings these joints straight; but she cannot extend the fingers. When the hand and forearm are pronated there is a complete drop of the wrist. Cannot raise wrist or fingers. Cannot move the thumb outwards or backwards (through loss of power of the extensor). There is almost perfect power of supination when the elbow is fixed. When the fingers are completely fixed, she is able to extend the joints between the second and third and first and second phalanges, by means of the lumbricales and interossei. When doing so, as the hand is very thin, the interossei can be seen working. There is slight numbness on the back of the thumb and index-finger, but no absolute loss of sensation.

Now this case closely resembled the last in all respects, with the sole exception of the paralysis of the hand and arm not being so complete.

The general aspect of the limb was the same. The pronation and flexion of the forearm and wrist were marked; but the power of supination was not completely lost—in fact, existed to a considerable degree, but was not perfect. So also with regard to extension of the hand from the wrist. The knuckles could be brought up nearly to their proper level. Now this imperfect power of supination and of extension of the hand was doubtless due to the supinator longus and extensor carpi radialis longior—muscles supplied by the radial nerve—retaining their power, and thus being able to act; whilst the short supinator and the short extensor of the wrist, both supplied by the posterior interosseous nerve, were completely paralysed. Hence the imperfection of the supination and extension that existed. There was further proof of the fact of the radial nerve having continued to maintain its action in the fact that sensation was not lost in its terminal cutaneous branches. The temperature of the hand also had not fallen, as in the first case.

Case 53. Fracture of Lower Epiphysis of Humerus—Wrist-drop from Paralysis of Posterior Interosseous Nerve—Tonic Contraction of Flexors.—M. M., aged seven, was admitted as an out-patient under Mr. Heath, and by him transferred to me. In June 1870, she fell over a croquet hoop, and the lower part of the right humerus was fractured. The arm was at first supposed by her friends to be dislocated, and a non-medical gentleman who was present pulled violently at it for some time, but as he did no good, she was taken to a medical man. Splints were used for seven weeks; they reached from the tips of the fingers, which were kept extended. When the splints were left off the fingers became flexed at once. Her parents thought they were more so than on admission. She could crochet with the right hand, and could write, but badly; she had been learning to write with the left hand in consequence. She had very marked wrist-drop; she could, however, easily extend her wrist. Her hand was pronated, and could only be imperfectly supinated. The fingers were flexed and drawn into the palm of the hand. On the wrist being dropped, the last two phalanges of the fingers could be imperfectly extended by the patient. On the wrist being straightened, the fingers became flexed, and could not be extended actively or passively. On forcibly extending the fingers and wrist, there was no tension of the palmar fascia, but there was great tension of the flexor tendons above the wrist. The hand was congested and cold. The arm was distinctly smaller than the other. The temperature of the right palm was not high enough to move the index of the thermometer—so that it is below 85°, that of the left being 93·6°. The sensibility of the hands was tested by compasses; it seemed quite as acute in the right as the left. There was some irregularity of the lower end of the outer condyle, which seemed to have been the situation of the fracture, or separation of the epiphysis, which was the original injury.

Dec. 19th.—I ordered a splint to be specially constructed so as to permit of gradual extension of the fingers by means of a movable hand-piece worked by a rack and pinion.

Jan. 14th, 1871.—I ordered her arm to be faradised daily. There was at first scarcely any contractility perceptible in the extensors.

9th.—The splint has been applied, and the arm has been galvanised daily. The contractility of the extensors and supinators has markedly increased.

23rd.—The fingers have become sore from the pressure of the instrument. The index-finger is but little improved. The middle finger is better, and the little and ring fingers are very much so, being now almost straight. The wrist can be extended perfectly, so that the knuckles can be brought to a level with the back of the forearm. When so extended,

the fingers are half bent. But when the wrist is dropped they can be extended by the patient. In doing this they always involuntarily spread out in a fan-shape, owing to the action of the dorsal interossei.

It would appear that the chief resistance to proper extension was due to the contraction of the flexor carpi radialis and the flexor tendon of the index-finger, both of which are very tense. I proposed to divide these subcutaneously; but the child's friends would not give their consent, and the patient was consequently discharged from the hospital.

In this case, also, we had the partial loss of supination and of extension dependent on the paralysis of the posterior interosseous nerve; whilst those movements that were due to the interossei and lumbricales were perfect. The contraction of the flexors, which had become very marked, was apparently due to the loss of action of their antagonist muscles. It was most marked in the flexors towards the radial aspect of the forearm, and was also associated with a tonic pronation of the limb. The muscles thus injuriously affecting its movement had apparently undergone some rigid atrophy; and I regret that the child's friends would not allow tenotomy, as it offered a good prospect of cure. The fall in the temperature of the hand was very marked. It amounted to at least $8\frac{1}{2}^{\circ}$ F., and how much more it was impossible to say, owing to the marking of the thermometer not admitting of a lower degree being noted. But the difference between the two hands in this respect was most obvious and very sensible to the touch. This great fall in the temperature of the hand is very remarkable when we reflect that it was due to paralysis of a branch of the musculo-spiral which is not directly distributed to the hand; whilst the other nerves of the hand—the median and ulnar and cutaneous branch—were intact, and gave no evidence of paralysis. The movements of the muscles of the hand itself, and the sensibility of the skin covering it, were normal.

LECTURE XII.

ON THE MEDICO-LEGAL ASPECTS OF CONCUSSION OF THE SPINE AND SHOCK OF THE NERVOUS SYSTEM AND ON THEIR DIAGNOSIS.

THERE is no subject in forensic medicine more important, and there are few more difficult, than that which relates to the correct estimate of the nature, the extent, and the probable consequences of an injury of the nervous system sustained in a railway collision. The importance of an attentive study of these cases does not consist merely in the great frequency of their occurrence, though in this respect they stand in an unhappy pre-eminence—greatly exceeding in number all other cases put together, in which medicine and law are mutually brought to bear upon, and have to co-operate in, the elucidation of the truth. But the consideration of these cases from a medico-legal point of view is a matter of the greatest importance by reason of the difficulties with which they are surrounded and the obscurity in which they are enveloped. In this respect their investigation resembles somewhat, and is only equalled by, that of cases of alleged insanity.

In those cases of injury of the nervous system that become the subject of medico-legal enquiry there is, as in cases of alleged insanity, no material difficulty experienced in the determination of the various questions that may arise in the more severe and obvious forms of disease. But it

is far otherwise in the slighter and more obscure cases. In these, not only may the question be raised as to the actual existence of the alleged symptoms; but their existence having been admitted, the surgeon must determine the value to be put upon them as evidences of real organic disease, or of mere functional disturbance. And in reference to the ultimate fate of the patient he must state to what extent recovery is likely to take place—and when it may be expected. In addition to all the intrinsic difficulties, which are necessarily connected with such cases, there is under-lying, and greatly disturbing their simple professional aspect, the great question of the amount of pecuniary compensation that should be granted for the consequences of the alleged injury. Here we have a disturbing element that, happily, never intrudes itself into other questions of surgery, and into very few of forensic medicine. But it is an element of disturbance, to the effects of which due weight must be given by the medical attendant in so far as it affects the morale of the patient, for it is apt to influence him injuriously in more respects than one, by leading him either wilfully or unconsciously to exaggerate his symptoms, just as he is very apt to over estimate his business losses and the pecuniary expenses entailed by the injury.

But, remember, if I advise you not to neglect to take this question of pecuniary compensation into your consideration, it is only so far as it affects the patient's symptoms and the estimate he forms of his own condition. In no other way can you as medical men—either as the surgeon to the railway company, or still less, if possible, as the private medical attendant of the patient, have anything whatever to do with the matter. This is a question that is altogether out of our province. A medical man who considers it in any way except in its influence on the mental, and through that on the physical, state of the patient, meddles with what neither concerns him nor his profession, and places himself in a false and unenviable position. Let me, therefore, urge upon you, when you are engaged in these compensation cases, never under any circumstances to allow yourselves to be drawn into a discussion as to the amount of money payment to be made to the sufferer, unless the matter is expressly referred to you by the counsel employed by both parties. But even then, I would advise you, if possible, to avoid being placed in the undesirable position of arbitrator. You may be sure that neither party will be satisfied with your decision. The fact is, that a compensation claim for alleged injury is made up of various elements, of which the personal injury is only one. This, which is alone the surgeon's province, in reality often counts for very little in the case. The losses sustained in business; the expenses, medical and others, directly incurred by the patient or to which he is liable to be put as the result of the injury, constitute, as a rule, the heavier and more important items in the claim for compensation; and these are matters that lie in the province of counsel, attorneys, and accountants, and are altogether foreign to that of the surgeon. Mental sufferings, bodily pain and disability, the diminution of that physical and mental vigour in which the enjoyment of life so largely consists, even complete annihilation of the prospects of a life, weigh lightly in the scales of Justice, which are made to kick the beam only by the weight of the actual money loss entailed by the accident.

When a person who has been present in a railway accident, and who alleges that he has been injured, is presented to you for your surgical opinion, you will find that the case has to be regarded from four points of view, viz. :—

1. As to whether he has really been injured.
2. If injured, what is the nature and extent of the injury?

3. Whether the injuries are permanent or not ?

4. If not permanent, then when will he be restored to health ?

Now the difficulty of determining these points, and of answering these questions, more especially the two first, will depend greatly upon whether you are the medical attendant of the patient and are employed on his behalf, or are engaged for the interests of the railway company.

If you are the medical attendant of the sufferer from the alleged negligence of the company's servants, or are consulted by him, you will have abundant opportunities of seeing him and of judging of him at different times—often, perhaps, when he does not expect your visit. If you happen to be his regular medical attendant, you will be able to compare his physical and mental state after the accident with what it was previous to that occurrence. But the case is widely different if you are employed on behalf of the railway company, whether as their regular surgeon or for the purpose of advising them with respect to a special case. In these circumstances your position is one of equal difficulty and delicacy. In accordance with the *lex non scripta*—that somewhat vague code of honour that goes by the name of 'professional etiquette'—you cannot, and in no case, or under any pretence whatever, ought you to visit the patient after you have given him the first attentions required on the occurrence of the accident, and after he has been removed to his own house, except in the presence of, or in consultation with, his own medical man. The patient is not yours—he probably does not wish to consult or even to see you. Perhaps, you are admitted to an interview with him and to an examination of him only after consultation with his solicitors and by their consent, or in virtue of a judge's order. He most probably looks upon you as being hostile to him, and as coming with the view of making light of his misfortunes. Hence, you will usually have but few opportunities allowed you of seeing the patient—generally only one—at most, two or three. He is always prepared beforehand for your visit ; he is excited, annoyed, or apprehensive with respect to it ; you do not consequently see him in his usual frame of mind ; and the mental disturbance thus occasioned may re-act injuriously upon and greatly aggravate his physical ailments. Above all, you have no opportunity of taking him unawares and unprepared when your visit is not expected, and when you would have a good opportunity of judging whether this symptom or the other in reality exists, or if it exists to the alleged extent.

The difficulties that surround an investigation by the railway surgeon are therefore very great and often embarrassing, and frequently render it extremely unsafe for him to come to any very decided opinion upon the case, unless the symptoms presented by it are very marked and of the nature termed 'objective.'

Much delicacy and tact also are required in these examinations when they are conducted by the surgeons employed by the railway company. The patient should be dealt with kindly and in a straightforward manner ; his tale listened to with patience, and his physical examination conducted with gentleness, care being especially taken to avoid the infliction of unnecessary pain, or doing anything that may bear the interpretation of cruelty or even harshness.

In these surgical examinations no solicitor should be allowed to be present on either side ; and should the patient's legal adviser insist on being in the room, it is better for the examining surgeon to withdraw. This investigation is a purely surgical one. The presence of the patient's own medical adviser is ample protection to his interests, and a solicitor is necessarily out of place in a proceeding which is beyond the limits of his own profession. I have actually known a solicitor attend

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1. Whether the patient has really been injured ; and,
2. If injured, then what is the nature and extent of the injury ?

The answers to these questions involve the diagnosis of the case ; and here let me tell you how and by what method you may be led to arrive at the truth in this important particular.

In effecting a diagnosis you may look upon a patient very much in the same way as a lawyer looks upon a reticent witness in the box. You must take it that you have before you a person who is not disposed to tell the truth. It is your business to elicit the truth ; and just as a skilled counsel employs a certain method which experience has taught the members of his profession tends to elicit that truth—experience confirmed, perhaps, by his own sagacity and natural instinct—so the surgeon employs a certain method to elicit the truth which the patient is perhaps unable to reveal, even though he be willing to do so, and which the disease cannot tell us. In making a diagnosis you will find that you have to employ both your senses and your judgment. In fact, a diagnosis is established by a method of observation ; observation being nothing more than the application of the senses, tempered, modified, and improved by the judgment. The mere use of the senses will not enable you to effect a diagnosis. You may see without perceiving. You may hear and not be capable of understanding. You may touch and yet be unable to feel. You must learn how to effect a diagnosis by the combined influence of study and practice. Mere study will not give it to you. No man, however much he may consult books, and however learned he may be in surgical literature, can possibly, by the aid of book-learning alone, distinguish elasticity from fluctuation. No surgeon understands intuitively the nature of a complicated injury or disease the first time he sees it. You must complement study by practice. You must study in order that you may know what you may expect to find, and this you will learn from the accumulated experience of your predecessors, which is to be found in books, or heard in lectures. To find it you will need the cultivation of your senses. It is, therefore, by that combined influence of study and practice, of learning and judgment, that a diagnosis is ultimately effected.

In effecting a diagnosis in these as in all other surgical cases, you will find that the patient will present two distinct classes of phenomena, and it is very important to bear in mind the distinction and the difference that exist both in kind and in importance of those two classes. He will, in the first place, present a series of phenomena which are recognisable by the surgeon himself, however unable the patient may be, from his injury or disease, to explain them. These are commonly called *objective*, and are described, or ought to be described, in surgical language as '*signs*.' Let me give you an illustration. A man is brought into the hospital unconscious, with a laceration of his scalp, with a depression of his cranium, and with bleeding from the ear. He is unable to tell you a single word ; but you recognise his condition at once by the local signs just mentioned, coupled with the more general signs, perhaps, of dilated pupil, heavy stertorous breathing, and slow pulse. These are the signs that he presents, and these signs are unmistakable by the surgeon. They indicate at once, without a word from the patient, without the necessity of putting a question to anyone, what his actual condition is.

But there is another series of phenomena presented by the patient which are of less importance than those that I have just mentioned, and that series of phenomena goes by the name of '*symptoms*.' They are *subjective*—that is to say, they are not recognisable by the surgeon, but are taken upon the statement made by the patient. The surgeon can

form no judgment of them except so far as the patient tells him. A man, for instance, comes to the hospital complaining of a violent pain in his head. You cannot possibly determine whether he has got that pain or not, except by his own statement. He tells you he has, and you must take it that he has got it, especially if he presents other phenomena that are corroborative of that statement. Pain is a symptom. All symptoms are taken upon the assertion of the patient, and they are all incapable of proof by the surgeon, except so far as his reliance on the patient's statement is concerned, whatever be the value of that as a matter of proof. You will therefore see that there is an immense difference in point of value as well as in kind between a sign and a symptom. But there is a further difference between the two. A sign indicates not only the fact of a lesion, but it indicates the very nature of that lesion in the majority of cases. It is, or it may be, the lesion itself. A symptom merely indicates the fact of there being a disturbance of some kind, but it does not indicate more than that. It in no degree shows what the nature of that disturbance is. In making a diagnosis, then, always bear in mind the difference of value between signs and symptoms, between the objective and subjective phenomena presented by the patient.

The symptoms presented by the patient himself are, as I have already said, subjective—they are only known to and must be described by the patient himself; and here the surgeon gets upon totally different ground, and has to exercise a considerable amount of caution in effecting his diagnosis, because the patient will very frequently do one of three things. He may unconsciously exaggerate his symptoms—that is a condition that is extremely common in nervous and hysterical persons; he exaggerates not only the actual existence of any symptom, but its relative importance to others. One symptom has chiefly attracted his attention, and on that he dwells. He employs exaggerated language in describing it; he will tell you that he has got an 'agonising' pain, a 'distracting' pain; he will use the strongest expletives in that way in connection with his symptoms, often unconsciously exaggerating the importance of one particular symptom. Then, again, he will sometimes, and for various reasons, consciously and designedly either exaggerate or conceal symptoms. Patients often do both—unconsciously exaggerate and wilfully mislead—and it is very important for the surgeon not to be deceived in these respects, and to use his utmost powers of cross-examination and of searching enquiry in order to elicit whether symptoms which are described really exist, or whether symptoms which in reality do exist are designedly kept in the background. Here the difficulties of diagnosis become great, but fortunately it is but rarely, except in cases of nervous shock, that the surgeon has to deal with cases in which the phenomena presented to him are purely subjective, and in which subjective cannot be supplemented or corrected by objective phenomena which I have already described as being so infinitely more important.

Well, then, when we have to give an answer to the first question, viz., whether the patient has really been injured, or whether he is malingering, let me always advise you to look out for some *objective* symptom—some *sign* on which you may rely as being beyond the patient's control, incapable even of exaggeration, whether that exaggeration be wilful or unconscious.

In the class of cases that we have been considering the chief signs on which you may place reliance as consisting of objective phenomena, the verification of which does not admit of doubt, are, 1. Ophthalmoscopic signs furnished by the examination of the fundus oculi; 2. Paralytic phenomena; 3. Alteration in size of a limb; 4. Diminution of sensi-

bility, as determined by the æsthesiometer ; 5. Diminution or loss of electric irritability and sensibility ; 6. Unnatural and persistent rigidity of muscles of the spine or limbs ; 7. Diminution or elevation of the temperature, and, 8. Indications afforded by the state of the pulse, tongue, digestive organs, &c. Indications furnished by one or other of these signs cannot deceive, and not only do they not deceive as to the actual existence of definite lesion of the nervous system, but they go further, and they afford valuable and reliable information as to the extent and degree of that lesion, and thus serve as foundations for the answer to the second question I have put, viz., Admitting the existence of an injury to the nervous system, what is its nature and extent ?

But even in regard to objective phenomena you may be deceived, unless great care be taken. And here I must tell you that an extensive experience in railway compensation cases will probably impress you more with the ingenuity than with the honesty of mankind. A history of deception practised on railway companies by alleged sufferers from accidents upon their lines, would form a dark spot on the morality of the present generation. Railway companies, it is true, are not particularly tender-hearted in their dealings with the victims of their own negligence and mismanagement, and too often treat those who have really seriously suffered with a degree of suspicion which is as unjust as it is vexatious. And their officials, too, frequently throw every obstacle that the law can furnish in order to retard or even to frustrate a just and equitable compensation for the injuries that have in reality been sustained. But, in justification of the companies, it may fairly be contended that they are so frequently the subjects of a degree of deception that actually amounts to a conspiracy to defraud them, that the public is not free from blame if suspicions are unjustly aroused and manifested in regard to some cases that are in all respects genuine. I will relate two or three instances to you to show how important it is, even when objective signs present themselves, not to be too hasty in concluding that these are the *bonâ fide* results of the injuries sustained.

Thus I have known cases in which persons who happened to be in a railway collision, but who were uninjured by it, have attributed to this accident injuries previously and elsewhere sustained, and have actually brought actions for compensation for the old and antecedent injury. I will give you one case out of several that have come to my knowledge. The wife of a ' respectable tradesman ' brought a child about eight years of age to consult me relative to an inflamed knee-joint. She stated that she and her child had a short time previously been in a collision on a railway ; that the child was thrown out of her lap and struck its knee violently against the edge of the opposite seat. There was an abrasion of the skin covering the patella, corresponding to the seat of the alleged blow. The inflammation of the joint went on from bad to worse, until at the end of about three months I was obliged to amputate the leg. An action was brought against the company by the father of the child, as its next friend, for the loss of its limb consequent on the injury to the knee alleged to be sustained in the collision. The company would certainly have been cast in very heavy damages, if their enquiries had not led them to a knowledge of, and enabled them to establish the fact that, about a week before the collision, the child had fallen at play and cut its knee upon a stone ; that the joint was inflamed and under treatment at the time of the collision, and that in the railway accident itself it had escaped all injury.

In another case a gentleman alleged that he had received an injury of the back in a railway collision. After a time he began to suffer from albuminuria. His condition was attended by many anomalous symp-

toms, and occasionally with the presence of a small quantity of blood in the urine. It continued for many months, resisting the treatment to which he was subjected by his own medical attendant, by myself, and by several physicians who saw him in consultation from time to time. The case came to trial. The plaintiff received heavy damages, and very speedily got rid of his albuminuria. From circumstances that subsequently came to my knowledge I was satisfied that the albumen had been skilfully mixed with the urine.

In another case, a patient who had been present in a railway collision continued for nearly twelve months in a state of complete prostration; suffering, according to his own statement, intensely from pain in his spine, and being utterly incapacitated for business. He could not stand without crutches, and was barely able to walk a few yards with them, dragging one leg in a helpless manner behind him. He received ample *solatium*, and in less than a month had not only lost the pain in his back, but thrown away his crutches, and had so far recovered his business aptitude that he was able to travel many hundred miles by railway in the active prosecution of his business.

I mention these cases, and I might greatly multiply them, to show you that even when *objective* symptoms, often of the most marked character, are present, you must not at once conclude that there is neither imposture nor gross exaggeration.

Diagnosis.—There is a form of deception occasionally practised, against which it is necessary for the surgeon to be on his guard. It consists in concealing the existence of an old-standing chronic disease, and assigning the symptoms and low state of health resulting from it to the accident itself. Thus a person knowing that he suffers from chronic albuminuria, may keep the surgeon in ignorance of the fact, and attribute the wasting, vomiting, cerebral and ocular disturbances consequent on this affection to the shock of the accident.

It is difficult to lay down any rules for the guidance of the surgeon in such cases. The diagnosis must at best be left to his practical tact and professional sagacity. But it may be stated broadly that when he finds that the patient presents symptoms of constitutional derangements which are out of all proportion severe as compared with the nervous shock, his suspicions should be roused, and a minute investigation instituted into the patient's antecedent health and the actual state of his organs.

I have already spoken of the comparatively small value to be attached to mere subjective symptoms in comparison to what is to be given to objective signs. But yet in a certain, and by no means small, proportion of cases of nervous shock, these are the only phenomena that will present themselves to you. These subjective symptoms may be wilfully invented in order to mislead, or may, if existing, be either consciously or unconsciously exaggerated.

Malingers may often be detected by taking off their attention in conversation; by desiring them to show their tongue, &c., and then finding that some symptom of which they made great complaint, such as pain in the spine on pressure, or a spasmodic movement of a leg or an arm, was no longer felt, or suddenly ceased. But although, undoubtedly, in many cases, deception may thus be readily enough detected and exposed, yet this test is by no means an infallible one. In the first place the malingerer may be on his guard, and thus frustrate the attempt to entrap him. But even if the pain is not complained of, or if the spasmodic jerk of the limb ceases when the attention of the patient is called off, it does not follow that he is practising a cheat. I have seen a spasmodic jerk of the leg in one case, and a constant tremor of the hand in

another, suddenly cease when the patient was desired to put out his tongue, in cases of disease not resulting from injury, in which there was no suspicion of, and no object to be gained by, malingering. And as to the spinal tenderness, I have found it disappear in hysterical girls when attention was strongly directed elsewhere. We must not, therefore, necessarily consider the cessation of these symptoms when the attention is taken off as evidence of malingering, but we may, I think, fairly take it as evidence that the particular symptom, whether it be pain or spasm, does not arise from organic disease, but is the consequence of mere functional disturbance, and so far the test is a very important one.

When invented, or wilfully exaggerated in order to mislead, the fraud may usually be detected by a surgeon accustomed to these investigations, finding that the symptoms do not bear a due proportion to one another; that one is brought into greater prominence than the rest, and that the patient contrives to direct attention to, and to lay emphatic stress on it. There is, in fact, an absence of that harmony of symptoms, if I may use such an expression, which characterises all true and real diseases.

The same may be said with regard to that mendacious exaggeration which is so constantly found associated with the hysterical or emotional temperament, or with distinct hysterical and emotional manifestations, both in the male and in the female. In such persons the exaggeration does not confine itself to one symptom, but pervades the whole of the condition, mental as well as physical.

In making a diagnosis founded on purely subjective symptoms, you must then most certainly take the entire condition of the patient and estimate its value as a whole. Judge if the parts of which it is composed are consistent with the alleged conditions, and are in proper harmony or relation with one another. In these cases you must take the whole group of symptoms. It is most unfair to break it up and to dissect each separately. Any one symptom may be common to several conditions; may by itself indicate nothing positive or precise, but in their entirety the symptoms may be indicative of a state of real disease. Thus, for instance, a pain in the head, impairment of memory, confusion of thought, inability to maintain a continuous train of thought, incapacity for ordinary business of life, dreams of a distressing character, weakness of sight, general debility, an irritable temper, muscular weakness, coldness of extremities, quick and feeble pulse, &c., may each individually be referable to a vast variety of constitutional and local conditions, but if taken collectively, *and as a group*, they certainly indicate a weakened and irritated nervous system, and if following close upon an injury which induces general shock of the nervous system, or which influences the nervous centres, may be fairly taken as the result of such injury.

In reference to this general discussion I may fairly put the matter thus: that one single objective sign, as, for instance, the loss of electric irritability in the muscles of one leg, may be taken by itself and independently of any other sign, symptom, or abnormal manifestation, as being absolute and irrefragable evidence of paralysis of that limb, consequent on spinal lesion. Whereas no one of the subjective symptoms that I have just mentioned is by itself proof of any disease whatever. Any one of them may be the simple consequence of fatigue, of exhaustion from excesses, &c., but yet taken collectively, they may fairly be taken as evidence of nervous shock. And the weight to be attached to them is, I need not say, greatly increased by the determination of the co-existence of one or more of the objective signs already mentioned.

It is important to make the diagnosis between the three pathological conditions that may result from concussion of the spine, viz., myelitis,

meningitis (separately or combined), and anæmia of the cord. And the importance of the diagnosis rests on this point, that in the two first conditions the primary inflammation is apt to be followed by such changes in the structure of the cord and its membranes as will leave organic lesions—possibly of a permanent character—whilst in anæmia of the cord nutritive changes seldom go on to permanent impairment of function; and the disease is, as a rule, far more amenable to treatment.

'Weakness' and 'paralysis' are not convertible terms when applied to the condition of the muscles of a limb. In 'weakness' all the movements of which a part is naturally capable are perfectly and equably performed, though their force is lessened, and the possible duration of their action materially curtailed. But in 'paralysis' there is either complete loss of all motility of the muscles of a part, or there is an irregularity in the movements of which it is normally susceptible; some being wholly lost, whilst others are more or less persistent. There is a loss of equipoise between opposite and antagonistic sets of muscles, and thus various deviations of the part from its natural shape may be occasioned, such as drooping, contraction, inversion, or extension.

In making the diagnosis between spinal anæmia, myelitis, and meningitis, there are four conditions to be attended to; namely, the local symptoms, the influence of therapeutic agents, the temperature of the body, and the ophthalmoscopic appearances.

So far as the local symptoms are concerned, it will be found that in spinal anæmia there is always pain at one or more points along the vertebral column. This pain is associated with diffused cutaneous hyperæsthesia of the back. The pain is severely complained of if the patient is moved by the surgeon, but it will be observed that he may move himself in dressing and undressing without exhibiting any evidence of suffering. Although there is much cutaneous hyperæsthesia, there is often a good deal of deep-seated tenderness, especially on pressing on either side of the spinous process in the inter-vertebral spaces. The paralysis, if any, is incomplete, there is no affection of the sphincters, no cramps or chronic spasms; there is often a general emotional or hysterical condition associated with the spinal symptoms; the general appearance of the patient is anæmic, the pulse quick, feeble, and compressible. These symptoms are not progressive, will rapidly attain their culminating point, and there remain stationary for a great length of time.

In myelitis the pain in the spine is localised, there is little if any cutaneous hyperæsthesia. The localised pain is greatly increased by all movements of flexion, rotation, or by pressure downwards. It is greatly increased by percussion, the application of heat, or any act, indeed, which influences the spinal column sufficiently deeply to convey an impression to the contained inflamed medulla. There is in these cases always a sensation as if the cord were tied tightly round the body on a line corresponding with the seat of inflammation. The paralysis is often quite complete, the sphincters are affected; there is atrophy of the limbs, their nutrition being acutely interfered with.

In meningitis the general symptoms more or less closely resemble those of myelitis, for indeed it is almost impossible to find meningitis existing without a certain inflammatory implication of the cord. Theoretically, the two diseases may be considered apart, but clinically they are almost invariably associated. In meningitis, however, there are these additional symptoms, clonic spasms, often of a painful character, frequently more or less permanent contraction of certain muscles or groups of muscles, and in both myelitis and meningitis there is, as a rule, a total absence of the hysterical condition.

There are two therapeutic tests which are of considerable value in confirming the diagnosis between these several conditions. Spinal anæmia is always benefited by strychnine and iron. It is usually considerably aggravated by the bromides. The reverse is the case in meningo-myelitis. In this condition strychnine greatly aggravates the symptoms which the bromides commonly have a tendency to alleviate, those at all events that are dependent upon the concomitant cerebral irritation.

The ophthalmoscopic appearances are also of considerable service from a diagnostic point of view. In spinal anæmia we have a pallid condition of the optic disc, which in the more advanced cases may proceed to white atrophy. In the inflammatory states of the cord and its membranes, more especially in meningitis, there is considerable hyperæmia of the fundus of the eye.

There are six special conditions from which the diagnosis of spinal concussion has to be made. They are : 1. The secondary consequences of cerebral commotion ; 2. Rheumatism ; 3. Hysteria ; 4. Injury to nerve trunks ; 5. Typhoid fever ; 6. Syphilis.

1. From *the secondary effects of cerebral commotion* it is not difficult to diagnose the consequences of concussion of the spine in those cases in which the mischief is limited to the vertebral column. The tenderness of the spine, the pain on pressure and movement, the rigidity of its muscles, and the absence of any distinct sign of cerebral lesion, will sufficiently mark the precise situation of the injury.

But it must be remembered that the two conditions of cerebral and spinal concussion often co-exist primarily. The shock that jars injuriously one portion of the nervous system, very commonly produces a corresponding effect on the whole of it, on brain as well as on cord ; and, as has been fully pointed out in various parts of these Lectures, the secondary inflammations of the spine, which follow the concussion, even when that is primarily limited to the vertebral column and its contents, have a tendency to extend along the continuous fibrous and serous membranes to the interior of the cranium, and thus to give rise to symptoms of cerebral irritation.

2. From *rheumatism* the diagnosis may not always be easy, especially in the earlier stages of the disease, when the concussion of the spine and the consecutive meningitis have developed pain along the course of the nerves, and increased cutaneous sensibility at points. By attention, however, to the history of the case, the slow but gradually progressive character of the symptoms of spinal concussion, the absence of all fixed pain except at one or more points in the back, the secondary cerebral complications, the gradual occurrence of loss of sensibility, of tinglings and formications, the slow supervention of impairment or loss of motor power in certain sets of muscles—symptoms that do not occur in rheumatism—the diagnosis will be rendered comparatively easy ; the more so when we observe that in spinal concussion there is never any concomitant articular inflammation, and that although the urine may continue acid, it does not usually become loaded with lithates.

But although the diagnosis may not be very difficult from the more acute forms of rheumatism, it is by no means easy to distinguish some of the secondary consequences of concussion of the cord from the more chronic and subacute varieties of the disease. In these cases, however, the following points if attended to may clear up the nature of the case. In rheumatism of this form the pain is muscular, is increased by movements of the affected muscles, and is influenced by atmospheric vicissitudes. In the diffused pains of spinal concussion it will be found that the central point of the pain is the spine, that it is aggravated by pres-

sure over or movements of the vertebral column, that muscles may be rigid but are not painful, that the pain takes the anatomical course of certain sets of nerves, of those in fact connected with the central spinal pain. In addition to this the history of the case, and the absence of cerebral complications in the muscular forms of rheumatism, will determine the real nature of the case.

In some cases of incipient paraplegia one or both knees may swell and become tender from the stress thrown on them in painful efforts to walk, and possibly also from faulty nutrition. This condition may lead to a suspicion of rheumatism; and, indeed, there may be gouty or rheumatic arthritis of a low form connected with, and partly dependent on, the paraplegic state, the symptoms of which will be evident in the limbs below the knees and quite independently of any affection in them.

So far as the *special* diagnosis is concerned of concussion of the cord in its primary and secondary symptoms from various other analogous and complicating conditions, I must refer to other parts of these Lectures. Thus you will find the diagnosis between hysteria and the symptoms of Concussion of the Cord given in Lecture VIII. p. 94, and that of sacrodynia, one of the most frequent and embarrassing complications or independent phenomena, described at length in Lecture IX. p. 99.

3. *Hysteria*.—From this manifestation of nervous disturbance I have already pointed out how the diagnosis of spinal concussions can be made (Lect. VIII. p. 94); I need not, therefore, repeat the cautions I there laid down.

4. The injury sustained by a large nerve trunk after its escape from the vertebral canal may lead to more or less paralysis of motion and sensation of the extremity or of the parts supplied by it. In this case the limitations of the loss of nervous power to the limb or even to one part of a limb—the absence of all central symptoms either in the spine or the head—will determine with sufficient accuracy the localised nature of the injury.

5. It might at first scarcely appear possible that any chance could occur of mistaking some of the secondary effects of concussion of the spine for the initiatory symptoms of typhoid fever. But yet the difficulty may arise, and has actually occurred in two cases in my own experience. There is of course no difficulty in the more advanced stages of typhoid by attention to thermometric indications, diarrhoea, the characteristic eruption, the state of the tongue, pulse, &c. But in the early stages the sudden accession of cerebral symptoms, such as frontal headache, delirium, somnolence, or maniacal excitement, may mislead the surgeon. And he may incorrectly refer these to an aggravation of the nervous symptoms resulting from the accident, when in reality they are due to this invasion of the initiatory stage of typhoid, which is apt to develop itself with cerebral complications owing to the pre-existing irritation of the nervous system. In one case which Dr. Maudsley saw with me, the patient, some weeks after a railway collision in which he had been severely shaken, became suddenly maniacal, stripped himself naked, and rushed out of the house in the middle of the night in this condition. The cause of this sudden exacerbation of nervous symptoms was very obscure for some days, when it was cleared up by the gradual development of typhoid fever. In such cases as these, indeed, the remark that I have already made more than once is peculiarly applicable, viz., to wait for time to clear up the diagnosis. What is obscure to-day will be patent to the most ordinary observer to-morrow.

6. *Syphilis*.—In syphiloma of the cord and its membranes various symptoms may be developed that closely resemble those presented by spinal concussion; but here attention to the history of the case, and the

co-existence of syphilitic lesions on the skin or mucous membrane, will determine its true nature. It must not, however, be forgotten that a patient suffering from constitutional syphilis may sustain an injury of the spine adding to the ulterior phenomena of spinal meningitis those of a specific character.

LECTURE XIII.

ON PROGNOSIS IN CONCUSSION OF THE SPINE IN ITS CLINICAL AND MEDICO-LEGAL ASPECTS.

THE prognosis or the determination of the course that the effects of the injury will take, and of the probable state of health of the patient, is one that is surrounded by difficulties of all kinds, and one on which it is often impossible for the surgeon to venture to give a definite opinion. Yet it is on this point that he is commonly most pressed to express himself dogmatically. The greater his experience the less ready will he be to hazard a positive opinion. For he will be able to call to mind many cases in which opinions confidently entertained and expressed by surgeons of the greatest eminence, and possibly by himself, have been falsified by the subsequent results. Hence he will seldom venture on anything more confident than a belief in the probability of a given result.

The prognosis of a case of spinal concussion involves three considerations.

1. As regards the life of the patient. Will the case terminate fatally or not?

2. If not fatal, whether the injuries are permanent or not?

3. If not permanent, then when will the patient be restored to health?

The prognosis of a serious injury of any part of the nervous system is always bad. I mean by serious, either severe in its primary effects or in its secondary consequences. A serious injury of the brain is never completely recovered from. However long the person may live, and however well he may have got over his accident, traces in some shape or another will continue. Change of character, irritability of temper, lessened aptitude for work of any kind, impairment of some senses—as of vision, abolition of others—as of taste or smell. All this is familiar to us after such injuries of the brain as produce structural changes. I believe it to be in some respects due to the cord, and that a structural change once effected as the result of injury, is permanent, and leaves more or less indelible traces of its presence in the modifications it induces in the functions of the cord. It is only in this way that we can explain the extreme tenacity in the persistence of certain symptoms after recovery from the general effects of the injury has long since taken place.

1. So far as life is concerned, it is only in those cases of severe and direct blows upon the spine, in which intra-spinal hæmorrhage to a considerable extent has occurred, or in which the cord or its membranes have been ruptured, or in other ways so seriously injured that acute softening ensues, that a speedily fatal termination may be feared. In such cases as these the danger is necessarily, *cæteris paribus*, greater in the cervical than in the dorsal—in the dorsal than in the lumbar region.

In some of the cases of concussion of the spine, followed by chronic inflammation of the membranes and of the cord itself, death may eventually supervene after several, perhaps three or four, years of an increasingly progressive breaking down of the general health, and the slow

extension of the paralytic symptoms in extent as well as in degree. I have known several instances in which concussion of the spine has thus proved fatal some years after the occurrence of the accident. And Mr. Gore, of Bath, who has had considerable experience in these injuries, writes to me in reference to the case related p. 83, that this is the third fatal case of which he has had more or less personal knowledge, the time from the injury to the occurrence of death varying from two and a half to five years.

In these cases, the fatal result is the direct effect of the structural changes that take place in the cord and its membranes. They prove in the clearest and most incontestable manner the possibility of death occurring after a lapse of several years, from the progressive increase of those symptoms, which are dependent upon disease of the nervous system from concussion of the spine occurring from slight and indirect accidents, and attended by the usual symptoms of such injuries; the fatal termination being gradually induced by the slow and progressive structural changes which take place in the cord. The case referred to establishes the fact beyond doubt that such a fatal termination is by no means impossible after an interval of several years, in cases of concussion of the spine in which deep-seated structural changes have developed in the cord.

The probability of such a melancholy occurrence is greatly increased if, after a year or two have elapsed from the time of the occurrence of the accident, the symptoms of chronic meningo-myelitis either continue to be gradually progressive, or, after an interval of quiescence, suddenly assume increased activity.

In fact, it is the excitation of this very form of disease, viz., chronic inflammation of the spinal cord and its membranes, that constitutes the great danger in these injuries of the spine. When it has once gone on to the development of atrophy, softening, or other structural changes of the substance of the cord itself, complete recovery is impossible, and, ultimately, death is not improbable.

Ollivier states as the result of his experience, that although persons affected with chronic myelitis may live for fifteen or twenty years, yet that they more commonly perish within four years. This opinion as to the probable future of patients unfortunately affected by this distressing disease is perhaps too gloomy, so far as the fatal result is concerned, but it is an evidence of the very serious view that a man of such large experience in the diseases of the cord took of the probable issue of a case of chronic inflammation of that structure, and it is doubtless explicable by the fact that Ollivier's experience has necessarily been chiefly drawn from idiopathic or constitutional affections of that portion of the nervous system; and these may justly be considered to be more frequently fatal than those forms of the disease that arise from accident to an otherwise healthy man not predisposed to such affections.

Ollivier takes an equally unfavourable view of the ultimate result of spinal meningitis, and probably for the same reason. He says,¹ 'Is spinal meningitis susceptible of cure? All observers agree in stating that death is the inevitable result.' In this, however, there can be no doubt that Ollivier was in error. I have seen cases of undoubted spinal meningitis recover. I may instance particularly one of a young lady 14 years of age, with an enormous congenital spinal bifida containing more than one hundred ounces of fluid. I cured the disease by repeated tappings and pressure combined. During the treatment symptoms of spinal meningitis came on with opisthotonos and convulsive movements,

¹ Vol. ii. p. 294.

but complete recovery gradually took place. Ollivier qualifies his statement, however, by saying that he has found in one case after death from other disease, old thickening of the membranes of the cord, and that Frank relates another in which a fatal termination did not occur. The occurrence of convulsive movements, however, is a most unfavourable sign. They indicate the existence of chronic myelitis, and are usually associated with deep disorganisation of the structure of the cord. They are of a most painful character, and are apt to be excited by movements and shocks of the body, even of a very slight character. With the exception of the case just mentioned, I have never known a patient recover who has been afflicted by them, progressive paralysis developing itself, and the case ultimately proving fatal. Mr. Gore, of Bath, informs me that he is acquainted with two cases which proved fatal at long periods of time after the accident, in both of which this symptom was present. One of these, a very healthy lad of nineteen, was injured on October 29, 1863, and died May 11, 1866. He suffered from convulsive attacks, with extreme pain in the spine, till the latter end of 1864, then the convulsions ceased, but the aching, wringing spinal pain continued; and his health broke down completely. Phthisis, to which there was no hereditary tendency, developed in the following spring, and he eventually died of that disease two years and a half after the injury.

From all this it is certain that concussion of the spine may prove fatal;—first, at an early period by the severity of the direct injury (Case 13); secondly, at a more remote date by the occurrence of inflammation of the cord and its membranes; and, thirdly, after the lapse of several years by the slow and progressive development of structural changes in the cord and its membranes (Case 12).

2. But though death may not occur, is recovery certain? May the effects of the injury not be permanent though they be not fatal? Is there no mid-state between a fatal result, proximate or remote, and the absolute and complete recovery of the patient?

Now this question of permanency of symptoms or of unlimited duration of effects of injury is one that you must approach with great caution, and on which a definite opinion is often impossible. Before proceeding to discuss it let us enquire what is meant by the 'recovery of the patient'? When you are asked, 'In your opinion will this patient ever recover?' what are you to understand by that question? Is it meant whether there will be a mitigation of the symptoms—an amelioration of health to some, perhaps even a considerable, extent—an indefinite prolongation of life, so that with care, by the avoidance of mental exertion and bodily fatigue of all kinds, the patient may drag on a semi-valetudinarian existence for fifteen or twenty years? Is this the meaning of the question? Is it meant that after a time even he may be able to return to his business—that he may be able to sit in his office or travel about the country? No, certainly not. A man may do all this and yet be far from well—be very far from having recovered. If that question has any definite meaning, it is whether the patient will in time completely and entirely lose all the effects of the injury he has sustained,—whether in all respects, mentally and bodily, he will be restored to that state of intellectual vigour and of corporeal activity that he enjoyed before the occurrence of the accident,—whether, in fact, he will ever again possess the same force and clearness of intellect, the same aptitude for business, the same perfection of his senses, the same physical energy and endurance, the same nerve, that he did up to the moment of his receiving the concussion of his spine.

In considering the question of recovery after concussion of the spine,

we have to look to three points: first, the recovery from the primary and direct effects of the injury; secondly, from the secondary and remote consequences of it; and thirdly, the time when such recovery is likely to take place.

There can be no doubt that recovery, entire and complete, may occur in a case of concussion of the spine when the symptoms have not gone beyond the primary stage, when no inflammatory action of the cord or its membranes has been developed, and more particularly when the patient is young and healthy in constitution. This last condition indeed is a most important one. A young man of healthy organisation is not only less likely to suffer from a severe shock to the system from a fall or railway injury than one more advanced in life, but, if he does suffer, his chance of ultimate recovery will be greater, provided always that no secondary symptoms dependent on organic or structural lesions have developed themselves.

I believe that such complete recovery is more likely to ensue if the primary symptoms have been severe, the result of direct injury, and have at or almost immediately after the occurrence of the accident attained to their full intensity. I have seen many instances of this, and would refer to Cases 1, 6, 7 as being illustrative of this fact.

In these cases, under proper treatment the severity of the symptoms gradually subsides, and, week by week, the patient feels himself stronger and better, until usually in from six to twelve months at the utmost all traces of injury have disappeared.

But incomplete or partial recovery is not unfrequent in these cases of severe and direct injury of the spine. Of this, Case 2 is an excellent illustration. The patient slowly recovers up to a certain point and then remains stationary, with some impairment of innervation in the shape of partial paralysis of sensation, or of motion, or both, usually in the lower limbs. The intellectual faculties or the organs of sense are more or less disturbed, weakened, or irritated, the constitution is shattered, and the patient presents a prematurely worn and aged look.

In such cases structural lesion of some kind, in the membranes, if not in the cord, has taken place, which necessarily must prevent complete recovery. When, therefore, we find a patient who, after the receipt of severe injury of the spine by which the cord has been concussed, presents the primary and immediate symptoms of that condition, such as have been described in Case 1, we may entertain a favourable opinion of his future condition, provided we find that there is progressive amelioration of his symptoms, and no evidence of the development of any inflammation, acute or chronic, of the membranes and the cord.

But our opinion as to his ultimate recovery must necessarily be very unfavourable, and the probability of his having been permanently injured will be greatly increased, if we find the progress of amendment cease after some weeks or months, leaving a state of impaired innervation, or of more or less complete paralysis. And this unfavourable opinion will be much strengthened if we find that subsequently to the primary and immediate effect of the injury, symptoms indicative of the development of meningo-myelitis have declared themselves. Under such circumstances of the double combination, of the cessation of improvement and the supervention of symptoms of intra-vertebral inflammatory action, partial restoration to health may eventually be expected; but complete recovery is hardly possible.

When a person has received a concussion of the spine from a jar or shake of the body, without any direct blow on the back, or perhaps on any other part of the body, and the symptoms have gradually and progressively developed themselves, the prognosis will always be very un-

favourable. And for this reason ;—that as the injury is not sufficient of itself to produce a direct and immediate lesion of the cord, any symptoms that develop themselves must be the result of structural changes taking place in it as the consequence of degeneration ; and these secondary structural changes being incurable, must, to a greater or less degree, but permanently, injuriously influence its action.

The occurrence of a lengthened interval, a period of several weeks, for instance, between the infliction of the injury and the development of the spinal symptoms, is peculiarly unfavourable, as it indicates that a slow and progressive structural change has taken place in the cord and its membranes, dependent upon pathological changes of a deep-seated and permanently incurable character. The progressive decadence of health and signs of disintegration of the nervous system are very slow in these cases. At first the patient merely feels weak, is not quite as well able to do a long day's business or professional work as before ; his friends and family observe a change in his character ; he becomes irritable, or taciturn and sullen ; he looks aged and careworn ; his incapacity for business increases ; his handwriting is changed for the worse ; the powers of walking are lessened, and the disposition to take exercise diminishes. All this goes on for many months, for a year or more ; then one leg begins to fail, usually the left ; he complains of coldness of the extremities, of various uneasy sensations in the hands—tinglings, &c. ; his vision becomes impaired ; he becomes very emotional, almost hysterical, between the fits of irritability, and at last unmistakable symptoms of paraplegia or of structural brain disease, hemiplegia, possibly aphasia, develop themselves. But the progress of the symptoms, however slow, has been continuous from the time of the accident. There may have been fluctuations in their severity, but never a complete interval of the same good health that existed before this occurrence.

Abercrombie truly says, 'Every injury of the spine should be considered as deserving of minute attention, and the most active means should be employed for preventing or removing the diseased actions which may result from it. The more immediate object of anxiety in such cases is inflammatory action ; and we have seen that it may advance in a very insidious manner, even after injuries which were of so slight a kind that they attracted at the time little or no attention.'

Well, then, when you see a patient suffering from the secondary effects of a slight injury of the spine, these effects having developed in an insidious but progressive manner, examine him with minute attention ; and if you find evidence of inflammatory action in the cord and its membranes, as indicated by symptoms of cerebral irritation, spinal tenderness and rigidity, modifications of sensation, as pains, tinglings, and numbness in the limbs, and some loss of muscular or motor power, with a quick pulse, functional derangement of the abdominal and pelvic organs, and a shattered constitution, you must, at any period of the case, however early, give a most cautious prognosis. And if many months—from six to twelve—have elapsed without any progressive amelioration in the symptoms, you may be sure that the patient will never recover so as—to use the common phrase—'to be the same man' that he was before the accident. But if, instead of remaining stationary, a progressive increase in the symptoms, however slow that may be, is taking place, more and more complete paralysis will ensue, and the patient will probably eventually die of those structural spinal lesions that have been described, or from the extension of diseased action to the brain and its membranes, and the development of incurable cerebral disease.

I have purposely used the words 'progressive amelioration' for this reason, that it often happens in these cases that under the influence of

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I have purposely used the words 'progressive amelioration' for this reason, that it often happens in these cases that under the influence of

change of air, of scene, &c., a temporary amelioration takes place—the patient being better for a time at each new place that he goes to—or under every new plan of treatment that he adopts. Fallacious hopes are thus raised which are only doomed to disappointment, the patient after a week or two relapsing, and then falling below his former state of ill-health.

In forming an opinion, then, as to the patient's probable future state, it is of less importance to look to the immediate or early severity of the symptoms than to their slow, progressive, and insidious development. Those cases are most likely to be permanently injured in which the symptoms affect the latter course.

The time that the symptoms have lasted is necessarily a most important matter for consideration. When they have been of but short duration, they may possibly be dependent on conditions that are completely, and perhaps easily, removable by proper treatment, as, for instance, on extravasation of blood, or on acute serous inflammatory effusion. But when the symptoms, however slight they may be, have continued even without progressive increase, but have merely remained stationary for a lengthened period of many months, they will undoubtedly be found to be dependent on those secondary structural changes that follow in the wake of inflammatory action, and that are incompatible with a healthy and normal function of the part. I have never known a patient to recover *completely and entirely, so as to be in the same state of health that he enjoyed before the accident*, in whom the symptoms dependent on chronic inflammation of the cord and its membranes, and on their consecutive structural lesions, had existed for twelve months. Such a patient may undoubtedly considerably improve, but he will never completely lose the traces of the injury. These will in some respects be permanent, and show themselves in general or local weakness, loss of muscular power, change in character, various head symptoms, each trivial in itself, but collectively important; a cachectic and prematurely aged look, and digestive derangement. And though, as Ollivier has observed, such a patient may live for fifteen or twenty years in a broken state of health, the probability is that he will die in three or four. There is no structure of the body on which an organic lesion is recovered from with so much difficulty and with so great a tendency to resulting impairment of function as that of the spinal cord and brain; and with the single exception, perhaps, of the eye, there is no part of the body on which a slight permanent change of structure produces such serious impairment and disturbance of function as on the spinal cord.

The cases in which complete recovery may be expected are those, then, in which the patient is young, in which the symptoms have been the effect of direct injury; in which they have rapidly attained their maximum of severity; in which early and continuous amelioration has taken place; in which they are referable to strain of the ligaments of the spine and to the muscles of the back; to irritation of the nerves in their exit from the vertebral canal; to lesion of nerve-trunks rather than of cerebral mischief; and, above all, to extravasation of blood into, or to irritation of the meninges, rather than a direct primary lesion, or to secondary structural change of the cord itself.

In those cases, also, in which the emotional, the hysterical, or the hypochondriacal element has from the first been largely associated with the signs of special or local lesion, a very favourable prognosis may be given, and a speedy restoration to health usually predicted, the more so when the associations attendant on litigations are removed, which in these cases exercise an important influence in depressing the mental and moral tone of the patient, and thus materially tending to perpetuate his despondent and nervous condition.

I may take this opportunity of discussing a question which, though it has no direct bearing upon the diagnosis, or even the prognosis, of these injuries, frequently springs out of the consideration of these points in the case; I mean the discrepancy of opinion that frequently arises amongst medical men, and which develops itself in the evidence given in courts of law, when these cases of alleged spinal injury and nervous shock become the subject of judicial investigation.

That conflicts of opinion as to the relations between apparent cause and alleged effects; as to the significance and value of particular symptoms, and as to the probable result or prognosis of any given case, must always exist, there can be no doubt. And this is more likely to happen when the assigned cause of the evil appears to be trifling; when the primary effects of the injury are slight; when the secondary phenomena develop themselves so slowly and so insidiously that it is often difficult to establish a continuous chain of connection between them and the accident. Such discrepancy of opinion is in these complicated cases not only inevitable, but legitimate; and for the conflict of views to which it leads in medical evidence—when these views have relation to matters of opinion only, and not to matters of fact—much and very undeserved blame has been cast on medical witnesses.

It is important to observe that it is not as to the recognition of facts, objective symptoms, or positive signs that are presented in any given cases of injury, when the physical lesion is distinct; but it is in the inferences to be drawn as legitimate deductions from these facts, that conflict of opinion and discrepancy in evidence may occasionally arise; and I have no hesitation in saying that in at least nine-tenths of all the railway or other accidents that are referred to surgeons of experience for arbitration or advice, there is not only no serious difference of opinion as to the true nature of the injury sustained, and none even as to its probable resulting effects on the patient locally or constitutionally, immediately or remotely. But in a certain small percentage of cases in which it may not always be easy to establish to demonstration the relation between the alleged cause and the apparent effect, in which the symptoms come on slowly and insidiously, or where they may possibly be referable to constitutional or local conditions quite irrespective of and antecedent to the alleged injury, and in which the ultimate result is necessarily most doubtful, being dependent on many modifying circumstances; in such cases, I say, discrepancy of professional opinion may legitimately, and indeed must necessarily, exist. There is no fixed standard by which these points can be measured. Each surgeon will be guided in his estimate of the importance of the present symptoms, and of the probable future of the patient, by his own individual experience or preconceived views on these and similar cases. But, in these respects, such cases differ in no way from many others of common and daily occurrence in medical and surgical practice. We daily witness the same discrepancies of opinion in the estimate formed by professional men of the nature and the future of obscure cases of any kind. In cases of alleged insanity, in the true nature and probable cause of many complicated nervous affections, in certain insidious and obscure forms of cardiac, pulmonary, and abdominal disease; in such cases as these we constantly find that '*quot homines tot sententiæ*' still holds good. Even in the more exact science of chemistry, how often do we not see men of the greatest experience differ as to the value of any given test, as to the importance of any given quantity of a mineral,—as of arsenic, mercury, or antimony, found in an internal organ—as an evidence of poisoning.

There are in fact two questions usually presented to the surgeon in these cases, the answers to which stand in very different categories;

one being capable of a positive reply, the other being usually open to doubt. The first question is as to the value of any one symptom or group of symptoms as indicative of the fact of the occurrence of injury. The second is that, admitting the injury, what will be the probable duration of the evils entailed by it, and will the ultimate result be a complete cure or only partial recovery? Now, except in some peculiarly obscure and complicated cases, in which the actual state is rendered uncertain by previous diseases or injuries, there cannot be, and in practice there is not, any possibility of a conflict of opinion in the answer to the first question, which relates simply to matters of fact.

But it is in reference to the second point that the conflict of opinion so often arises. Here we have not a question of fact to be decided by observation. We have not even a question as to the absolute or relative value of the facts so observed, but we have to draw inferences from facts the existence of which is disputed or perhaps only partially admitted. Even if the surgeons are fully agreed as to the facts of the injury—its cause, its nature, or the reality of the symptoms, the real difficulty—the stumbling-block—then presents itself, which is as to the probable future, for they are required to enter on the debateable land of prophecy, to form part of the *genus irritabile vatum*, and to forecast the patient's future. They are asked to speak, and often requested to speak positively, in reply to the questions, on which it is impossible to dogmatise, viz., whether the recovery will be partial or complete; and further than this, if partial only, then to what extent? If complete, then at what period? Here a difficulty at once arises which is felt throughout the whole domain of pathology. These are questions, the difficulty in answering which is by no means confined to the complicated injuries of the nervous system, but extends to the simplest cases in surgery and in medicine. Thus, for instance, a man breaks his leg close to the ankle-joint. No difference of opinion does, or probably can, exist as to the cause of the injury, its nature and extent; but if asked to give a dogmatic opinion as to the future condition of that man's limb—if he will ever recover so as to be able to use it as well as before it was injured, and if so, how long it will be before he can walk, run, and jump with as much facility and safety as before the accident? Or, if he will not wholly recover, and be permanently injured, to what extent that permanent injury may interfere with his activity, so that though he may be able to walk, whether he will be able to run; and if he can walk and run, whether he can ever jump? How can it be possible for any surgeon to give a positive answer to such questions, and still less for any body of men to agree on any answer, except that it would be impossible to reply with any degree of precision to questions such as these. So with regard to an injury of the nervous system. The injury is admitted, but the question immediately comes, Is this injury temporary or permanent? Are the symptoms dependent on it referable to functional or organic lesion? Admitting that strength of mind and clearness of intellect are materially impaired or dimmed, when will they be restored? Admitting that the patient cannot think, read, or calculate as he was accustomed to do before the accident, when will he be able to do so as clearly, as continuously, and as correctly as before he was injured? Is it not probable, nay, is it not inevitable, that in the answers to questions such as these, differences, and possibly conflicts, of opinion will arise? But such differences are inherent in the very nature of the subject. They are not dependent on any uncertainty that specially pertains to medicine, but on the impossibility of drawing definite and precise conclusions from indefinite premises. It is as unreasonable to complain of the uncertainty of medical science because such questions

as these cannot be answered with absolute or even approximate precision, as it would be to complain of the uncertainty of engineering science because any given number of engineers might, and certainly would differ, if they were required to say how many miles an axle with a flaw in it could run without breaking down. The truth is, that such questions cannot be answered in a definite, categorical, or even dogmatic manner, and the surgeon should always decline to give a positive reply to a question that has reference to the possible future of a case, more especially when the element of time is associated with that of recovery; when, in other words, he is required not only to say whether the patient will get well, but to state when, or, still worse, to say when he will 'be sufficiently recovered to attend to business.'

Were public discrepancies of opinion confined to the members of the medical profession it would be a lamentable circumstance, and one which might justly be supposed to indicate something deficient in the judgment, or wrong in the morale, of its members. But when we look around us, and enquire into the conduct of members of other professions, we shall find that in every case in which the question at issue cannot be referred to the rigid rules of exact science—whether it be one of Engineering, of Law, of Politics, or of Religion—the same conflict of opinion will and does, as a matter of necessity, exist, and the same subjects and the same phenomena will present themselves in very varying aspects to the minds of different individuals,—conflict of opinion being the inevitable result.

Look at any great engineering question. Are not engineers of the highest eminence to be found ranged on opposite sides in the discussion of any point of practice that has become one of opinion, and that cannot be decided by a reference to those positive data on which their science is founded? Is there no discrepancy of opinion often manifested among gentlemen of unimpeachable integrity in their profession, as to possible causes of that very accident, perhaps, which has occasioned the catastrophe that has led to the presence of the surgeon in the witness-box?

Is the law exempt from conflicts of opinion, independently of those that are of daily occurrence in its Courts? Are there no such institutions as Courts of Appeal? Are decisions never reversed? Are the fifteen Judges always of one mind upon every point that is submitted to them? Do we never see conflict of opinion spring up in the Lords and Commons, amongst the magnates of the legal profession, on questions that involve points of professional doctrine and practice?¹

¹ 'Reference is often made by public writers to the conflict of opinion which is commonly found amongst medical witnesses. Lawyers are most apt to refer to this diversity of judgment—rarely in complimentary terms—most often to suggest or point the conclusion that judgments so divided in their course and so little consistent are of slight weight and deserve little consideration. A barrister furnishes us this week with facts that should modify that opinion, if strict analogy can serve to afford an illustration or to point an argument. The analysis of the decisions of Lord Justice Giffard, sitting alone in appeal cases from January to June 1870, shows that of forty-one appeals from various courts, the decisions of those courts were affirmed in seventeen cases, reversed in nineteen cases, and varied in five cases. In applying this illustration to the cases of difference of opinion amongst medical experts in courts of justice, it must be remembered that in the great majority of cases to be decided—say 90 per cent. of railway compensation cases—medical opinion is unanimous. And such cases do not come into court. It is only where doubts and difficulties arise that a judicial decision in court is ordinarily asked. The cases of agreement, which are most numerous, are settled out of sight. Moreover, it is only fair to take into account the essential elements of mystery, individual vital differences, and special combinations, which surround each medical case, and obstruct the arrival at tainty. In legal decisions, all the conditions are known, and the principles to be

Is the Church herself free from differences of the widest kind on questions that we are taught are of the most vital importance? Have we not for years past heard questions of doctrine, of practice, of ritual, discussed with an amount of vehemence and zeal, and with a conflict of opinion, to which we can find no parallel in our own profession? Are not angry passions roused in quarters where they are little to be expected, and may we not at times be tempted to exclaim, '*Tantæne animis celestibus iræ*'?

The truth is that these conflicts of opinion are common to all the professions and to every walk of life. Religion and Politics, Law and Medicine, and the Applied Sciences, all contain so much that is, and ever must be, matter of opinion, that men can never be brought to one dead level of uniformity of thought upon any one of these subjects; and out of the very conflicts of opinion that are the necessary consequence of the diversity of views that are naturally entertained, Truth is at last elicited.

Far be it from me to do otherwise than to speak with the utmost respect of a learned and liberal profession, when I say that slight discrepancies of opinion arising between medical men are often magnified by the ingenuity of advocates, so as to be made to assume a very different aspect from that which they were intended to present, and are exaggerated into proportions which those who propounded them never meant them to acquire. Perhaps we are often ourselves not altogether blameless in respect to the misapprehension that may arise. We, as medical men, are guilty of two errors in giving our evidence. We are apt, in the first place, to be too dogmatic in our opinions; and secondly, too inexact or too technical as to the language in which we convey them, and in which we state our facts. However necessary it may be for a teacher or practitioner to assume a dogmatic tone in order to press home a truth on a class not over attentive, or on a patient not too willing, it is well to avoid an exhibition of this quality in a court of law. So also it is well to avoid the use of technical or scientific language for the expression of facts that can be stated in plain English. The same words or modes of expression that would be not only intelligible, but would convey a very definite meaning with them in the discussions of a medical society, would be misunderstood or prove confusing to a jury unacquainted with medical phraseology. Technical language puzzles and confuses, but does not convince, and medical men, in the statement of facts as well as in the expression of opinions, cannot be too careful in the use of it. But not only is it necessary to avoid being too technical, the medical witness should endeavour to express himself as succinctly and as clearly as possible. We deal habitually with the material rather than the ideal, with facts rather than with words, and are frequently somewhat inexact in the expressions we use. Mere verbal differences, mere diversities in modes of expressing the same thing, are thus sometimes twisted into the semblance of material discrepancies of statement and opinion. How often have I heard in courts of law attempts made to show that two surgeons of equal eminence did not agree in their opinions upon the case at issue, because one described a limb as being 'paralytic,' whilst the other perhaps said 'there was a loss of nervous and muscular power in it,'—when one said that the patient 'dragged' a limb, the other that he 'walked with a certain awkwardness of gait.' The obvious professional moral to be deduced from this is, that it is

applied are ascertainable. The process is one of pure reasoning, free from conjecture. Yet it does not seem to be productive of complete unanimity in the end.'—*British Medical Journal*, June 18, 1870.

impossible for you to be too precise in the wording of your expressions when giving evidence on an obscure and intricate question. However clear the fact may be to your own minds, remember that it may not be so obvious to others who do not possess the peculiar technical knowledge that you have acquired. If it be stated obscurely, or in terms that admit of a double interpretation, you may be sure that the subtle and practised skill of those astute masters of verbal fence who may be opposed to you, will not fail to take advantage of the opening you have inadvertently given them, to aim a fatal thrust at the value of your evidence. And indeed, the expression that is in itself perfectly definite, and that admits of no ambiguity in the mind of a medical man, may present a very different meaning to one who does not possess the requisite amount of anatomical or pathological knowledge to be able correctly to appreciate its true purport. Thus, for instance, the word 'spine' is used by an anatomist as signifying only the column, whereas a non-medical man will usually employ it as including the cord as well as its enclosing case. In doing so, let me advise you to confine yourselves as strictly as possible to answering concisely and intelligibly the question put to you. It is seldom desirable to volunteer statements of your own. When you find it necessary to do so in order to make your answer more clear, or to explain away any misconception that may arise as to your meaning, you must not do so until after you have answered the question put to you. Answer first, explain, if necessary, afterwards. But let me advise you to have recourse as little as possible to independent statements and unasked-for explanations. Your doing so may place you in a wrong position, in that of an advocate rather than of a witness. It is impossible to impress upon you too strongly how very important it is not only that you should not be a partisan in the case, on one side or the other, but that you should not appear to be so. It is the duty of a medical witness above all others to assist the court in a thoroughly unbiassed spirit and straightforward manner, without reference to the side on which he has been called. A medical witness is not retained to advocate the cause of either plaintiff or defendant. It is his duty to give a truthful and clear description of the facts that he has observed, and to the best of his ability an unprejudiced opinion, founded on the inferences that he draws from these facts. It is the business of the advocate, and not that of the medical witness, to place the cause of his client in the best possible light by sifting the accuracy of the facts deposed to, and to elicit the truth by questioning the validity of the opinions expressed.

There is a very important difference in the prognosis of spinal and cerebral affections, according as they arise from disease or injury. Hence a very different estimate of the duration and gravity of such affections is apt to be entertained by the physician and the surgeon. When a given train of spinal or cerebral symptoms, whether acute or slowly progressive, is the result of disease, it is invariably indicative of structural changes in the cord or brain; possibly of an incurable and probably of a progressive character, due to failure of nutrition, as in atheroma of the nutrient arteries, or to remote visceral disease, as of the kidneys or heart.

When the same spinal or cerebral symptoms are the result of injury—the whole of the evil is often produced at once—there will in time be a tendency to repair rather than to degeneration, and the patient is probably otherwise perfectly healthy.

The difference in the importance of the same symptom, according as it is the result of progressive degeneration or of sudden injury—as it arises from what may be termed a medical or from a surgical cause—is

well illustrated by Paraplegia. If this condition arise spontaneously, it is probably due to softening and degeneration of the cord, and will be incurable. If it be the result of injury, it may be owing to hæmorrhage into the spinal canal, and will disappear as the blood is absorbed. So with Unconsciousness. This condition, however transitory, occurring suddenly independent of injury, is justly regarded by the physician as a symptom of the gravest import, probably of an epileptic nature. Trousseau, indeed, regards unconsciousness without convulsions, the 'petit mal,' as more serious than the major epileptic seizure with convulsions. But the same importance cannot be attached to it when it follows a head-injury. I do not speak only of the unconsciousness which occurs at the moment of the concussion of the brain, but of that occasional attack of momentary loss of consciousness which may ensue at a later period. Serious as this symptom undoubtedly is, and partaking as it doubtless does of the epileptoid character, it stands in a totally different category, so far as the future of the patient is concerned, to that occupied by the 'petit mal.' It is not, like it, progressive or destructive of mental vigour and capacity, but may, and most probably will, ultimately disappear without leaving any impairment of intellectual power. These examples might easily be multiplied. But what I have given will suffice to direct attention to one cause of that conflict of opinion, well known in the prognosis of a case, which is often observed between physicians and surgeons, due to one class of practitioners being accustomed to see a particular set of symptoms develop as the result of pathological lesion, and leading to disorganisation of structure; the other observing them as occasioned by injury, and tending to repair of tissue.

Inequality of knowledge will certainly cause conflict of opinion. He who is content with the knowledge of the pathology of the nervous system as it existed twenty, fifteen, or even ten years ago, cannot appreciate, and hence cannot coincide with, views founded on the more advanced and more accurate investigation of its diseases, and a clearer insight into the physiology of the brain and cord. But even between men equally well informed, conflicts of opinion are on certain points not only unavoidable, but perfectly legitimate, and reflect no discredit either on the science of medicine or on those who entertain conflicting views. On the contrary, such conflicts of opinion may be looked upon as highly creditable to the independence of thought and the individual self-reliance that characterise professional opinion at the present day.

The conflict of medical evidence often arises in consequence of a want of proper understanding between the medical men engaged on the opposite sides of the case. As matters are now arranged, there is, as I have already shown, no 'consultation,' in the proper sense of the word, between them. The surgeon of the company examines, it is true, the plaintiff before, and in the presence of his (the plaintiff's) own medical men; but there is no after-discussion of the case, no attempt, as in an ordinary consultation, to reconcile discordant views, and to come to a combined opinion on the case. Neither party knows the exact views of the other on any point, or on the value of any one symptom, until they are heard in court. This is a great evil, and might be corrected by the surgeons on the two sides meeting as ordinary consultants discussing the case together, and, if possible, drawing up and signing a conjoint report. If such a report could be obtained, it might be handed in for the guidance of the judge and counsel, and the strictly medical part of the case would be much simplified. In fact, it would be disposed of if all parties concerned had substantially agreed before the trial as to the nature, extent, and probable duration of the plaintiff's injuries and their consequences, the tripod on which the medical question always rests. In the

event of there being such discrepancy of opinion that an agreement could not be come to on any or all of these points, the judge should appoint at least two surgeons of known character, and of recognised skill in the particular class of injury under consideration, to draw up a report upon the plaintiff's past and present condition and future prospects. This report would serve to guide the Court in coming to an opinion on the purely surgical part of the case, and afford it that information which men who admittedly know little of a subject on which they are to decide must necessarily be supposed to wish to obtain. The experts or assessors who draw up this report should be appointed by the Court, and not by the litigants. Their position would consequently be an independent one. They could not be accused of unworthy motives. They could not be calumniated, and their evidence would not be disparaged by groundless charges of partisanship.

The report of such surgical assessors would necessarily be final. It could scarcely be successfully disputed by those medical witnesses from whose conclusions it differed. Hence it would be of paramount importance that none should be selected for such an important post as that of assessor who was not recognised as possessing not only a sound general knowledge of surgery, but such special experience in the diseases resulting from injuries of the cord and brain, as to render his opinion worthy of all consideration in the eyes of his professional brethren. Such a plan would not interfere with the present machinery of the courts. The case would continue to be tried in the ordinary common law courts, before a jury who would decide on all its facts. Their judgment, and that of the Court, would be guided in all matters of scientific opinion either by a conjoint surgical report, or, if that cannot be arrived at, by the written statement of competent surgical assessors, who, having had free access to the plaintiff and to the medical reports on both sides, could arrive at a definite and unbiassed conclusion as to the nature, extent, and probable duration of his injuries and their consequences. It would, I venture to submit, be in the highest degree advantageous to the medical as well as the legal profession. The great inconvenience of the system of indiscriminately subpoenaing medical practitioners who are but little concerned in the case would be stopped; conflict of medical evidence would no longer occur. Engendered as it is partly by the want of proper understanding between the medical witnesses, and greatly encouraged by the want of due scientific knowledge on the part of the Court, it would not survive the necessity of both parties either making a conjoint report or submitting their differences of opinion to the arbitration of skilled surgical assessors selected by the Court. And, lastly, the ends of justice would be attained with more certainty than they often are under the present system.

The conclusions that may be drawn from the foregoing observations are as follow :—

1. That a serious hardship is inflicted on medical men by the present system of uselessly multiplying medical witnesses in compensation cases.
2. That much evil results from the want of adequate scientific and technical knowledge on the part of the Court.
3. That the Court should be assisted by assessors of known skill and experience in surgery.
4. That such assessors should be appointed by the Court, and not by the litigants.
5. That the surgical witnesses on both sides should be required to meet and to draw up a conjoint report on the case before the trial comes on. Such report to be submitted to the Court for its guidance in the medical and surgical parts of the case.

6. That in the event of the surgical witnesses being unable to agree on the terms of such a report, the case be referred to the assessors, who will report to the Court on the nature, extent, and probable duration of the plaintiff's injuries.

7. That the report of the assessors be final.¹

LECTURE XIV.

ON THE TREATMENT OF CONCUSSION OF THE SPINE.

IN the treatment of a case of concussion of the spine the surgeon must bear in mind that he has not to do merely with an ordinary physical lesion, but with one that influences materially the moral and mental condition of the patient, and the symptoms of which are in turn seriously aggravated by that very moral depression which it has engendered. It becomes, therefore, a most difficult problem to solve how to combine that treatment which the injury that the spine has sustained may require with that calculated to prevent, or at all events not to augment, the hypochondriacal and hysterical states so often resulting from these accidents.

The primary and immediate treatment of a case of concussion of the spine presents nothing peculiar or that calls for special attention. The moderate administrations of diffusible stimulants, warm drinks, the repose of bed, and the local application of hot fomentations, if superficial or deep pain is suffered, comprise all that needs be done in these cases.

The after-treatment resolves itself into means for the alleviation or cure of those diseases which are the more remote consequences of the injury sustained by the vertebral column and its contents, or of the shock to which the nervous system has been subjected. It includes a variety of therapeutic means, amongst which rest, counter-irritation, electricity, absorbent, sedative, and tonic medicines are the more important.

The method of application and the mode of administration of these various local means and constitutional remedies present nothing that is in any way special in the treatment of these injuries.

The point that essentially, and at last must guide the surgeon in his choice of remedies, is the pathological condition that lies at the bottom of the secondary disease, induced by the concussion of the spine or the nervous shock to which the patient has been subjected. Is this sub-inflammatory, of the nature of meningitis, myelitis, or meningo-myelitis? or is it the very reverse, indicative of exhaustion or anæmia of the nervous centres? It is obvious that the determination of this point is of the first importance, and that the treatment which would be proper and beneficial in the one case would be in the highest degree improper and hurtful in the other. Bearing this in mind, let us consider more in detail the different means that we adopt. And first with regard to the treatment of the inflammatory state.

Rest.—The first thing to be done in a case of injury of the spine with concussion of the cord is undoubtedly to give the injured part complete rest. But rest of the spine means the prone or recumbent position con-

¹ See *Lancet*, vol. i. 1878; and 'Surgical Evidence in Courts of Law,' by the Author (Longmans, 1878).

tinuously maintained ; complete immobility of the body, the avoidance not only of walking and movement of any kind, but even in many cases of standing upright. It entails, consequently, an interruption, often a long suspension, of all the ordinary occupations of life. The idleness which is the necessary result of long-continued enforced rest is, however, apt to act injuriously on the mind, more especially in that large class of labouring or of active business men who with little intellectual culture, have, in illness, no mental resources to fall back upon, their lives having been spent from boyhood in a hard struggle for bare subsistence, or in the absorbing pursuit of gain. These men, who are amongst the most frequent sufferers by railway collisions, truly 'know no Paradise in rest,' and to them the long-continued monotony of a sick room is a source of much mental depression, which is often aggravated by the loss of the means of sustenance, and by the corroding cares of the *res angustæ domi*, consequent on the annihilation of all business income. The consequences entailed by rest thus exercise a most injurious influence in still farther depressing the moral tone and mental elasticity which have already been seriously shaken by the effects of the accident for which repose is enjoined.

But notwithstanding these concomitant and unavoidable ills, rest, absolute and complete, is a necessary preliminary to, and accompaniment of, all other treatment in every case of injury of the spine, whether from direct violence, strain, or wrench, that is accompanied by symptoms of concussion of the cord, and above all, by those of meningomyelitis.

The importance of rest cannot be over-estimated in these cases. Without it no other treatment is of the slightest avail, and it would be as rational to attempt to treat an injured brain or a sprained ankle without repose, as to benefit a patient suffering from a severe concussion or wrench of the spine unless he is kept at rest. In fact, owing to the extreme pain in movement that the patient often suffers, he instinctively seeks rest, and is disinclined to exertion of any kind. It is the more important to insist upon rest when, however, the cord rather than the column is injured, for not unfrequently patients feel for a time benefited by movement—by change of air and of scene. And hence such changes are thought to be permanently beneficial. But nothing can be more erroneous than this idea, for the patient will invariably be found to relapse and to fall back into a worse state than had previously existed. The truth is, that in most of these cases of spinal concussion there is mental disturbance as well as physical derangement. New scenes benefit the mind and cheer the spirits, but the exertion of travelling in search of them, and the necessity for increased bodily exercise are most injurious to the physical state and tend greatly to aggravate existing spinal irritation. In more advanced stages of the disease, when chronic meningitis has set in, the patient suffers so severely from any, even the very slightest movement of the body, from any shock, jar, or even touch, that he instinctively preserves that rest which is needed, and there is no occasion on the part of the surgeon to enforce that which the patient feels to be of imperative necessity for his own comfort.

In order to secure rest most efficiently, the patient should be made to lie on a prone couch. There are several reasons why the prone should be preferred to the supine position. In the first place, in the prone state the spine is the highest part of the body, and thus passive venous congestion and determination of blood to the spinal cord, which are favoured and naturally occur when the patient lies on his back, are entirely prevented, and that additional danger which may arise from this cause is averted so long as the prone position is maintained. Then

again, the absence of pressure upon the back is a great comfort in those cases in which, in consequence of injury to the vertebral column, it is unduly sensitive and tender. Lastly, the prone position presents this advantage over the supine, that it admits of the application of any necessary treatment.

To some patients the prone position becomes very irksome and cannot long be borne. It then becomes necessary to allow them to lie flat on the back, with the head slightly raised. There is this peculiarity about the maintenance of the supine position in these cases,—that the danger of sloughing of the back is but very small. It is remarkable, indeed, how very rarely this occurs. Hence the prone position is not necessary as a preventive of the complication.

The vitality of the paralyzed parts in paraplegia from concussion of the spine does not fall so low as it does in cases of compression or laceration of the cord in fractured spine.

Sloughing from pressure upon exposed and prominent parts, which is so common in paralysis after fracture of the spine, does not occur in cases of loss of power from spinal concussion. I do not remember ever to have seen a case in which confinement to bed or couch, even though prolonged for many months, was followed by this serious and often fatal consequence of ordinary traumatic paraplegia. In fact, in all these cases of concussion, bed sore may, with the most ordinary care and attention to cleanliness, and relief from pressure, be entirely prevented.

When the patient begins to move about, equal comfort and advantage will be derived from the use of the plaster of Paris jacket, the poroplastic jacket, of spinal stays, or a gutta-percha case, to embrace the shoulders, neck, and occiput, and support the back. In cases where the cervical spine alone is affected, the use of a stiff collar is beneficial.

But if rest is needed to the spine, it is equally so to the brain. I have repeatedly in these Lectures had occasion to point out the fact that in cases of concussion of the spine the membranes of the brain become liable to secondary implication by extension of inflammatory action to them. The irritability of the senses of sight and hearing, that is so marked in many of these cases, with perhaps heat of the head, or flushings of the face, are the best evidences of this morbid action. For the subdual of this state of increased cerebral excitement and irritability, it is absolutely necessary that the mind should be kept as much as possible at rest, and that disquieting influences and emotions should, as far as practicable, be avoided. The patient, feeling himself unequal to the fatigue of business, becomes conscious of the necessity of relinquishing it, though not perhaps without great reluctance, and not until after many ineffectual efforts to attend to it. Under these circumstances the brain must be allowed to lie fallow for a season. It is seldom necessary to insist on this absolute rest of brain in one who suffers from cerebral irritation. He finds it simply impossible to employ his mind on any subject that requires an effort of the intellect or the strain of sustained attention, without a great aggravation of his sufferings. But if unable to occupy himself with the ordinary business of his life, care must be taken that the patient do not suffer from the mental inaction and fall into a state of melancholia from the monotony of his enforced idleness; and attempts should be made to fill up the vacant hours by recreation of some sort.

But if rest is thus absolutely necessary in cases of meningitis and myelitis, it is not equally so in those cases of spinal anæmia, which so closely simulate real organic disease, and which are often associated with hysteria. In these cases the patient should be encouraged to move about; to be much in the open air. If unable to walk, then he must

use a carriage or a chair. But anyway, out-of-door life and exercise of some kind, though to a limited extent, will be useful.

Sleep.—Next to rest it is most important to endeavour to secure sleep in cases of concussion of the spine. It is impossible to expect that the nervous system can recover itself so long as the patient passes wakeful nights, or is disturbed by horrible dreams. Unfortunately in these cases narcotics are as a rule not well borne. The various preparations of opium and morphia, whether administered by the mouth or given hypodermically, are not only seldom successful in securing rest or in allaying pain, but are often positively injurious, at least so far as securing sleep is concerned. Chloral hydrate is more advantageous and safer than the opiates. It should be given in tolerably full doses, from 25 to 40 grains, either at once or divided in the course of the night. Next to the chloral hydrate, and especially in those cases in which there is distinct meningeal irritation, the bromides are of great service, and indeed, may often be advantageously combined with the chloral, tranquillising the cerebral irritation whilst the chloral more distinctly induces sleep.

Local applications.—The local treatment to be applied to the spine will vary according as we have to do with meningo-myelitis or anæmia of the cord.

In the inflammatory affection in the early stages, hot fomentations, leeching, or dry-cupping will be of essential service. At a more advanced period repeated blistering will be found to give great relief. I have never found it necessary to employ issues or setons, but if there is evidence of disease in the vertebral column itself, these might be employed with advantage. The pain which I have termed sacrodynia is little influenced by ordinary topical agents. The only means that I have found to ensure a beneficial influence on it have been active stimulants or counter-irritants, such as blistering, or the thermic hammer.

In the diffuse hyperæsthesia of spinal anæmia the ice-bag and the continuous galvanic currents are often useful. In these cases, also, various embrocations of belladonna, aconite, camphor, &c., will be found to allay pain and comfort the patient.

In the more advanced stages cold salt-water douches, or the shower-bath, will prove serviceable.

Medicines.—The iodide of potassium is of the greatest value in all those cases in which there are evidences of chronic or subacute meningitis. It should be given in full doses, and continued for a considerable length of time. It may be well to commence with 5 grains three times a day, and to carry it on gradually until from 15 to 20 are given for a dose. It is particularly in cases of muscular cramps or stiffness that the iodide is of service, and in those forms of fibroid or ligamentous tenderness that are frequent after wrenches of the spine, and that resemble rheumatism.

The bromide of potassium or of ammonium is useful in relieving the cerebral distress, irritation, or pressure, that is so frequently complained of as a concomitant symptom of meningo-myelitis.

The employment of the perchloride of mercury in certain forms of paraplegia was strongly advocated by Sir Benjamin Brodie and Dr. Latham. The great value of this remedy and of the iodide of potassium is universally admitted in syphilitic paralysis. In some of the traumatic forms of paraplegia the use of the perchloride is equally efficacious. In ordinary idiopathic paraplegia—in those forms of the disease that arise from other than traumatic causes, in which the paralysis is rather due to nutritive changes, leading to softening, to disintegration, and disorganisation of the substance of the cord itself than to inflammatory action developed in an otherwise healthy person—mercurials would un-

doubtedly be injurious rather than beneficial. So also in spinal anæmia they would be most hurtful.

But, on the contrary, in those traumatic forms of paraplegia dependent on pressure from extravasated blood, on inflammation of the meninges, on pressure on the cord from inflammatory effusions, the perchloride of mercury is undoubtedly most beneficial. It is in similar cases, and more especially in the more marked cases of meningitis of a sub-acute character—those cases in which there is morbid rigidity and contraction of muscles, that iodide of potassium is so markedly beneficial.

Treatment of Spinal Anæmia.—When the symptoms are rather those of spinal anæmia than of meningo-myelitis, the preparations of iron and strychnine will be found to be of the highest value; in fact, as has already been stated in the Lecture on Diagnosis, the tolerance or not of strychnine in these cases will serve as a therapeutic test of considerable value, as to whether the disease be one of spinal exhaustion or of inflammation. There is probably no better method of administering these remedies, in the majority of the cases that I have mentioned, than by giving a pill three times a-day containing a quarter of a grain of the extract of nux vomica with two or three grains of the dried sulphate of iron, or administering them in the form of the syrup of the phosphates of iron, strychnine, and quinine. But the precise method of administration signifies little, it is the principle on which I wish to insist, and to which I wish to direct your attention, that you must treat these cases of spinal anæmia by means of strychnine and iron in some shape or another. In addition to this, you will find it necessary to insist upon a liberal allowance of good food being taken with wine or beer. I have spoken of rest as being absolutely necessary in those cases in which there is meningo-myelitis; but in cases of spinal anæmia it is desirable that the patient should be as much as possible in the open air, carried out, laid on a mattress, drawn about in a Bath chair, when the season permits. The monotony of the seclusion to a bed-chamber is most injurious. Some mental occupation should be insisted upon; recovery is often materially retarded, and, indeed, the ill-effects in many of these cases of concussion of the spine, followed by an exhausted state of the nervous system, are greatly increased by want of employment, amusement, or mental distraction of some kind. The patient dwells upon his sufferings, becomes morbidly sensitive in mind, or melancholic and hypochondriacal. These mental conditions are especially apt to develop themselves in people of active business habits, with few intellectual resources. Such persons, when forced to lead a life of physical inactivity, have no means of filling up their time and occupying their thoughts by intellectual pursuits, even of a very simple character; and it is in them especially that a forced inactivity exercises so very prejudicial an effect in retarding or altogether preventing recovery. It is in these cases of spinal anæmia, and in such individuals especially, that change of scene is of great benefit. Injurious as travelling, and especially a residence at the sea-side, so commonly ordered in an inconsiderate off-hand manner is in cases of meningo-myelitis, it is of the utmost value in restoring the lost tone to the nervous system in cases of simple exhaustion of it.

Exercise is not advantageous whilst the nervous system continues in an exhausted or enfeebled state. Patients suffering from spinal anæmia may be benefited greatly by change of air and change of scene, their nutrition improved by the one and their mental tone invigorated by the other; but they are not improved by being subjected compulsorily to exercise. As they recover they will instinctively and proportionately to the return of strength resume their habits in this respect.

It is of great importance to keep up the temperature of the body, especially of the extremities, by artificial means. Unless this is done the circulation becomes retarded in the cold feet and hands: nutritive changes are ill-effected; the blood is cooled down in traversing parts the temperature of which is many degrees below the normal point. Carried back to the heart in this cooled-down state, it tends to depress its action, and thus to lower the force of the circulation throughout the body, and proportionately to lessen the energy of all those actions dependent upon its activity.

Electricity in its different forms is of extreme service in many cases of spinal anæmia and in the removal of local paralysis, whether it be connected with this condition, be the remote consequence of changes dependent on the structural lesions of the cord, or the effect of local injury of some nervous trunk.

For the necessary directions to guide the surgeon in the employment of electricity in these various cases, I must refer to the works of Reynolds, Althaus, and Duchenne. There is nothing special in the mode of its employment in traumatic cases that deserves particular notice. But there are a few words of caution and advice that I may give you with respect to the class of cases in which it is likely to be beneficial or hurtful.

Faradisation will be found of especial service in cases of simple loss of nervous power without any signs of concomitant inflammation, central or peripheral. Thus it will be found of great use in the paraplegia of spinal anæmia, in the loss of power in the extensors of the foot and toes and the peronei muscles dependent on paralysis of the external popliteal nerve, a form of paralysis that has frequently been referred to in these lectures, and of very common occurrence after spinal concussion; and lastly, in those localised forms of paralysis of the upper extremity dependent on affection of the supra-scapular, circumflex, or musculo-spiral nerves.

The continuous current applied to the spine is particularly useful in spinal anæmia and for the relief of the cutaneous hyperæsthesia associated with it.

Electricity in any shape is always hurtful when there are symptoms of subacute inflammatory action, especially of the meningeal form, associated with the paralysis, as indicated by muscular rigidity or painful cramp. I think that we may broadly say about this therapeutic rule with respect to the employment of electricity, that it is useful in those cases that are benefited by strychnine and iron; whereas, in those that are made worse by these remedies, electricity is equally hurtful, in fact, the injury resulting or benefit to be derived from the use of electricity will be in the exact ratio of the inflammatory or asthenic character of the paralysis.

The treatment of spinal anæmia may be summed up in a very few words—a cheerful life, plenty of fresh air, sea or mountain, well-ventilated rooms, repose but not solitude, warm sea-water bathing and douching, skin-friction, good food, iron, quinine, phosphorus, and strychnine. And should the spine be tender, repeated flying blisters to the painful parts; in fact, an hygienic, dietetic, and medicinal plan of treatment of a tonic character.

But whatever treatment be adopted, no speedy benefit can be expected. In the most favourable cases the duration of the symptoms will have to be counted by months, in many by years. For the health may continue permanently broken, or some local nerve lesion will persist in spite of the most careful treatment.

When the case involves a claim for compensation, care must be taken

to see that the treatment prescribed is properly carried out, and that the patient does not by neglecting it and nursing his symptoms mislead the surgeon as to the gravity and probable persistence of his condition and the inefficacy of treatment in relieving it.

The treatment of various local ailments consequent on or associated with the spinal injury need not detain us, as it must be conducted on general medical and surgical principles.



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